TABLE OF CONTENTS OF SPECIAL PROVISIONS

Note: This Table of Contents has been prepared for the convenience of those using this contract with the sole express purpose of locating quickly the information contained herein; and no claims shall arise due to omissions, additions, deletions, etc., as this Table of Contents shall not be considered part of the contract.

Table of Contents

AUGUST 19, 2020
FEDERAL AID PROJECT NO. N/A
STATE PROJECT NO. 0115-0121

PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

Town of Putnam
Federal Aid Project No. N/A

The State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 818, 2020, is hereby made part of this contract, as modified by the Special Provisions contained herein. Form 818 is available at the following DOT website link http://www.ct.gov/dot/cwp/view.asp?a=3609&q=430362. The current edition of the State of Connecticut Department of Transportation's "Construction Contract Bidding and Award Manual" ("Manual"), is hereby made part of this contract. If the provisions of this Manual conflict with provisions of other Department documents (not including statutes or regulations), the provisions of the Manual will govern. The Manual is available at the following DOT website link http://www.ct.gov/dot/cwp/view.asp?a=2288&q=259258. The Special Provisions relate in particular to the Putnam Repair Facility and Maintenance Facility in the Town of Putnam.

CONTRACT TIME AND LIQUIDATED DAMAGES

One Thousand Thirty Seven (1,037) calendar days will be allowed for completion of the work on this Contract and the liquidated damages charge to apply will be Three Thousand Seven Hundred Dollars ($3,700.00) per calendar day.

NOTICE TO CONTRACTOR - PRE-BID QUESTIONS AND ANSWERS

Questions pertaining to DOT advertised construction projects must be presented through the CTDOT Pre-Bid Q and A Website. The Department cannot guarantee that all questions will be answered prior to the bid date. **PLEASE NOTE - at 9:00 am Monday (i.e. typical Wednesday Bid Opening) the project(s) being bid will be closed for questions, at which time questions can no longer be submitted through the Q and A Website.**

Answers may be provided by the Department up to 12:00 noon, the day before the bid. At this time, the Q and A for those projects will be considered final, unless otherwise stated and/or the bid is postponed to a future date and time to allow for further questions and answers to be posted.

If a question needs to be asked the day before the bid date, please contact the Contracts Unit staff and email your question to dotcontracts@ct.gov immediately.

Contractors must identify their company name, contact person, contact email address and phone number when asking a question. The email address and phone number will not be made public.

The questions and answers (if any) located on the Q and A Website are hereby made part of the bid/contract solicitation documents (located on the State Contracting Portal), and resulting contract for the subject project(s). It is the bidder's responsibility to monitor, review, and become familiar with the questions and answers, as with all bid requirements and contract documents, prior to bidding. By signing the bid proposal and resulting contract, the bidder acknowledges receipt of, and agrees to the incorporation of the final list of Q and A, into the contract document.

Contractors will not be permitted to file a future claim based on lack of receipt, or knowledge of the questions and answers associated with a project. All bidding requirements and project information, including but not limited to contract plans, specifications, addenda, Q and A, Notice to Contractors, etc., are made public on the State Contracting Portal and/or the CTDOT website.

NOTICE TO CONTRACTOR – HAZARDOUS MATERIALS INVESTIGATIONS

A hazardous materials site investigation has been conducted at the Putnam Maintenance Facility, Putnam, Connecticut.

The results of the investigation identified asbestos-containing-materials (ACM), polychlorinated biphenyl containing materials (PCB), lead based paint (LBP) and miscellaneous hazmat items to be present at the site.

The Contractor is hereby notified that these hazardous materials requiring special management or disposal procedures will be encountered during various construction activities conducted within the project limits. The Contractor will be required to implement appropriate health and safety measures for all construction activities impacting these materials. These measures shall include, but are not limited to, air monitoring, engineering controls, personal protective equipment and decontamination, equipment decontamination and personnel training. WORKER HEALTH AND SAFETY PROTOCOLS WHICH ADDRESS POTENTIAL AND/OR ACTUAL RISK OF EXPOSURE TO SITE SPECIFIC HAZARDS ARE SOLELY THE RESPONSIBILITY OF THE CONTRACTOR.

The Department, as Generator, will provide an authorized representative to sign all manifests and waste profile documentation required by disposal facilities for disposal of hazardous materials.

The Sections which shall be reviewed by the Contractor include, but are not limited to, the following:

- Item No. 0020801A – Asbestos Abatement
- Item No. 0020902A – Lead Compliance for Building Demolition & Renovation
- Item No. 0101143A – Handling & Disposal of Regulated Items
- Item No. 0101183 – PCB Building Materials Removal

The Contractor is alerted to the fact that a Department environmental consultant may be on site for abatement and related activities, to collect environmental samples (if necessary), to observe site conditions for the State.

Information pertaining to the results of the limited hazardous materials investigation discussed can be found in the document listed below. This document shall be available for review electronically.

- Survey Report – Pre-Renovation Investigative Survey for Hazardous Building Materials – Putnam Maintenance Facility, Putnam, Connecticut, June 2019.

NOTICE TO CONTRACTOR – ENVIRONMENTAL INVESTIGATIONS

Scope of the planned Site improvements project includes: demolition of the existing maintenance/repair building; construction of new Maintenance and Repair buildings; removal of the existing Emergency Generator building and associated 275-gallon fuel oil above-ground storage tank (AST); removal of a 4,000-gallon heating oil underground storage tank (UST); removal of a 1,000-gallon oil/water separator (OWS); removal of two hydraulic lift systems; relocation of the current 6,000-gallon gasoline and 8,000-gallon diesel fuel ASTs; and construction of a new stormwater detention pond.

Several environmental investigations have been conducted that involved the sampling and laboratory analysis of soil and groundwater collected from various locations and depths within the Project Limits. Results of the investigations indicate the presence of polynuclear aromatic hydrocarbons (PAHs), extractable total petroleum hydrocarbons (ETPH), and arsenic at concentrations exceeding the applicable State of Connecticut Department of Energy & Environmental Protection (CTDEEP) Remediation Standard Regulations (RSRs) cleanup criteria in soil within the Project Limits. Specifically, soils with elevated PAH concentrations have been identified at shallow depths (i.e., 0.5 to 2.5 feet below grade) at various locations across the Site. Based on this information, the entire Project Limits have been designated as an Area of Environmental Concern (AOEC) for soils. The Contractor is hereby notified that Controlled Materials (i.e., soil) within the AOEC will require special management and/or disposal procedures.

All materials excavated from within the AOEC, excluding existing pavement structure (asphalt and subbase), ballast, rock, ledge, and concrete, are to be considered Controlled Materials. Such Controlled Materials shall be reused on the Project unless deemed unsuitable by the Engineer due to physical indications of contamination or geotechnical characteristics of the material. Such unsuitable material, and surplus Controlled Materials that cannot otherwise be reused on the Project, shall be transported to the designated temporary waste stockpile area (WSA). The location of the WSA is depicted on Drawing ENV-002 in the Project Plans. Construction and management of the WSA shall be performed in accordance with *Item No. 0101128A - Securing, Construction and Dismantling of a Waste Stockpile and Treatment Area*. **Note:** the Contractor is alerted to the potential requirement for relocation of the WSA from its initial location to another location on-site once during the Project, due to construction phasing. The Controlled Materials staged in the WSA will require disposal at an approved treatment/recycling/disposal facility in accordance with *Item No. 0202315A - Disposal of Controlled Materials*.

Excavated soils deemed suitable for reuse are to be reused on-site before other borrow material, such that materials requiring off-site disposal are minimized. Excavated material that is suitable for reuse shall be managed at the point of origin for use as backfill. In instances where such material cannot be reused directly at the point of origin or within several days of excavation, the material shall be managed, in a manner approved by the Engineer, to minimize generation of fugitive dust and erosion, and prevent physical interference with other Project activities. These soils shall be utilized as fill/backfill within the Project Limits, in accordance with the following conditions:

1. Such soil is deemed to be structurally suitable for use as fill by the Engineer;
2. Such soil is not placed below the water table; and
3. Such soil is not placed in an area subject to erosion.

The Project is located within a CTDEEP "GA" groundwater classification area and is also within a "Level A" Aquifer Protection Area. Available groundwater quality data from previous environmental investigations have indicated the presence of volatile organic compounds (VOCs), PAHs, ETPH and/or RCRA metals in Site groundwater. Specifically, detected concentrations of PAHs, ETPH, lead and/or arsenic above applicable RSR groundwater criteria were encountered in a number of sample locations in the southeastern portion of the Site. Therefore, this area of the Project Limits has been designated as a Groundwater Area of Environmental Concern (GWAOEC), depicted on Drawing ENV-003 of the Project Plans. Should dewatering be required during construction within the GWAOEC, such activities shall be performed in accordance with *Item No. 0204210A – Handling of Contaminated Groundwater*. In the event impacted groundwater is noted during removal of the 4,000-gallon fuel oil UST (e.g., visible petroleum sheen or free product), the Contractor shall be prepared to dewater the excavation as directed by the Engineer, to achieve compliance with the CTDEEP UST Regulations. Wastewater generated as a result of these dewatering activities shall also be managed in accordance with referenced *Item No. 0204210A*, which directs the Contractor to manage and treat such contaminated groundwater prior to discharge via sanitary sewer to the local publicly-owned treatment works (POTW) under CTDEEP's *General Permit for the Discharge of Groundwater Remediation Wastewater* (DEEP-WPED-GP-027).

Given the observed depth to groundwater elsewhere on-site, management of groundwater during construction in other portions of the Site is not anticipated. However, any dewatering that may be required outside of the designated GWAOEC shall be conducted in accordance with the CTDEEP's *General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities.*

The Contractor is hereby notified that Controlled Materials requiring special management and/or disposal procedures will be encountered during various construction activities conducted within the Project Limits. Therefore, the Contractor will be required to implement appropriate health and safety measures for all construction activities to be performed within the areas of excavation within the Project Limits. These measures shall include, but are not limited to, air monitoring, engineering controls, personal protective equipment and decontamination, equipment decontamination, and personnel training. WORKER HEALTH AND SAFETY PROTOCOLS WHICH ADDRESS POTENTIAL AND/OR ACTUAL RISK OF EXPOSURE TO SITE SPECIFIC HAZARDS ARE SOLELY THE RESPONSIBILITY OF THE CONTRACTOR.

The Sections which shall be reviewed by the Contractor include the following:

- Item No. 0101000A – Environmental Health and Safety
- Item No. 0100069A - Removal of Tanks
- Item No. 0100072A – Removal and Disposal of Underground Tanks
- Item No. 0101117A – Controlled Materials Handling
- Item No. 0101128A - Securing, Construction and Dismantling of a Waste Stockpile and Treatment Area
- Item No. 0101143A - Handling and Disposal of Regulated Items
- Item No. 0101185A – Removal of Hydraulic System
- Item No. 0202315A – Disposal of Controlled Materials

- Item No. 0202640A - 2-inch Well Abandonment
- Item No. 0204210A – Handling of Contaminated Groundwater
- Item No. 0202642A – Abandonment of Wells

The Contractor is alerted to the fact that a Department environmental consultant will be on-site periodically during construction operations to observe site conditions for the State. Information pertaining to the results of the environmental investigations discussed above can be found in the following documents. These documents shall be available for review on the Project portal in ProjectWise.

- Task 210 – Subsurface Site Investigation Report, Putnam Maintenance and Repair Facility, Putnam, Connecticut, TRC, January 2018.
- Letter to Adam Fox, P.E., Significant Environmental Hazard Assessment – May/July 2108, TRC, July 25, 2018.
- Supplemental Subsurface Investigation, Putnam Maintenance Facility – Building Renovations – July 2019, TRC, February 2020.

NOTICE TO CONTRACTOR – PROJECT DESCRIPTION

The Project consists of the construction of a repair facility and maintenance facility and the demolition of the existing combined maintenance and repair facility located at 3 Industrial Park Rd., Putnam, Connecticut.

Building work involves the construction of a maintenance building and a repair building. The maintenance building consisting of approximately 30,220 square foot of bay area and a 2,400 square foot office area. The repair building consisting of approximately 24,000 square foot of bay area and a 2,400 square foot office area. The new buildings will include operational areas for vehicle repair and maintenance operations, a materials storage stockroom, private office areas, and supporting office spaces. The buildings are steel frame construction with exterior steel siding and masonry. The work includes concrete, masonry, steel framing, steel joists, steel decking, wood, waterproofing, insulation, metal wall panels, PVC roofing, sheet metal, roof specialties and accessories, fireproofing, joint sealants, expansion control, doors and frames, sectional doors, aluminum and steel windows, hardware, glazing, louvers, metal framing and gypsum board, interior finishes, interior specialties, equipment, furnishings, tank monitoring system, conveying equipment, fire suppression, plumbing systems, heating-ventilating-air conditioning systems, electrical systems, communications systems, and electronic safety systems.

The work also includes the construction of a two cold storage building.

Site work consists of excavation and grading work to accommodate the buildings; regrading of site for storm runoff; removal and disposal of existing pavement; demolition and proper disposal of the existing maintenance/ repair facility building, and oil-water separator; construction of the facility structures and cold storage building structures; construction of a GPS station structure; demolition of existing motor fuel island and installation (relocation) of a motor fuel island and tanks, drainage, new utilities, new pavement, metal beam rails, curbing, fencing, pavement markings, turf establishment, landscaping, and exterior site lighting.

Environmental work includes work with polluted soils as further specified in the NOTICE TO CONTRACTOR – ENVIRONMENTAL INVESTIGATIONS. Such work will also include lead, PCB, and asbestos abatement and the removal and disposal of regulated items removed during the facility demolition, such as lights, ballasts, thermostats, and other similar items as indicated in the NOTICE TO CONTRACTOR – HAZARDOUS MATERIALS INVESTIGATION.

NOTICE TO CONTRACTOR – SUBMITTALS

Unless otherwise noted, the Designer will be the "submittal reviewer."

Any Product Samples that are to be sent to the Designer requiring review for conformance with the Contract shall be transmitted by letter and hand delivered or sent by mail directly to Mr. Christopher Bonsignore, P.E., Transportation Principal Engineer, Facilities Design, Bureau of Engineering and Construction, Connecticut Department of Transportation, 2800 Berlin Turnpike, P.O. Box 317546, Newington, CT 06131-7546, Room 3405.

The Engineer will be the "submittal reviewer" for the following materials:

Concrete Mix Design Certifications
Asphalt Mix Design Certifications
Erosion Control Plan and Materials
Demolition Plan
Disposal Plan
Welding (Welder) Certificates
Certified Test Reports, Material Certificates, etc. from Form 818 Standard Items (non "A" Items from Bid List)
"Non-A" items, including those items in CSI-formatted Specifications
All test reports identified in CSI-formatted Specification except for Testing, Adjusting, and Balancing Reports

Environmental Compliance will be the "submittal reviewer" for review of work identified in the following special provisions:

1. Item No. 0020801A – Asbestos Abatement.
2. Item No. 0020902A – Lead Compliance for Building Demolition and Renovation.
3. Item No. 0100072A – Removal and Disposal of Underground Tanks.
4. Item No. 0100069A – Removal of Tanks
5. Item No. 0101000A – Environmental Health and Safety.
6. Item No. 0101117A – Controlled Materials Handling.
7. Item No. 0101128A – Securing, Construction and Dismantling of a Waste Stockpile and Treatment Area.
8. Item No. 0101143A – Handling and Disposal of Regulated Items.
9. Item No. 0101185A – Removal of Hydraulic Systems .
10. Item No. 0101186A – PCB Building Materials Removal.
11. Item No. 0202315A – Disposal of Controlled Materials.
12. Item No. 0202640A – 2-Inch Monitoring Well Abandonment.
13. Item No. 0202642A – Abandonment of Wells.
14. Item No. 0204213A – Handling Contaminated Groundwater.
15. Item No. 0999002A – Disposal of Buildings.

FM Global is identified as an outside agency as a secondary "submittal reviewer" for review of work are identified in the following CSI Sections:

1. Division 05 Section 053100, "Steel Decking."
2. Division 07 Section 074213, "Metal Wall Panels."
3. Division 07 Section 075419, "Polyvinyl Chloride (PVC) Roofing."
4. Division 07 Section 076200, "Sheet Metal Flashing and Trim."
5. Division 07 Section 078413, "Penetration Firestopping."
6. Division 07 Section 078446, "Fire-Resistive Joint Systems."
7. Division 07 Section 083323, "Overhead Coiling Doors."
8. Division 07 Section 083613, "Sectional Doors."
9. Division 11 Section 111000, "Vehicle Service Equipment."
10. Division 13 Section 133419, "Metal Building Systems."
11. Division 21, Section 211313, "Wet-Pipe Sprinkler Systems"
12. Division 28 Section 283111, "Digital, Addressable Fire-Alarm System."

The Department will forward the noted submittals to FM Global for their review, with FM Global comments being sent back to the Department for inclusion in one response to the Contractor. Hence, the Contractor shall allow 28 calendar days for outside agency review of the submittals noted above.

*The Contractor shall send submittals e-mail alerts to the following key personnel:

Designer (Project Engineer):
Designer (Project Manager):
Designer (Consultant Project Manager):
Construction Project Chief Inspector:
Construction Supervising Engineer:
Owner:
Operator:

Add the following for submittals where Environmental Compliance is listed in <u>NOTICE TO CONTRACTOR – SUBMITTALS</u> as the "submittal reviewer:"

Environmental Designer (Project Engineer):
Environmental Designer (Project Manager):

*Key construction and engineer personnel will be identified at the Pre-Construction Meeting.

NOTICE TO CONTRACTOR – EARLY SUBMITTALS

The Contractor is hereby advised that the Department has identified the potential need to order certain materials and equipment, and thereby submit certain submittals for approval early in the construction process to ensure the Project is completed within the allowable Contract Time. Submittals shall be in accordance with Form 818 Article 1.20-1.05.02. The following items have been identified:

Materials Required for Concrete and Rebar
Oil-Water Separator
Aboveground Storage Tanks

The following items have been identified as possibly requiring early submission for purposes of project coordination and project work scheduling:

Baseline Critical Path Schedule
Contractor's Submittal Schedule
Utility Coordination
Environmental Submittals Required for Site Construction/Demolition

The lists above are not intended to be all-inclusive and do not relieve the Contractor from coordinating the activities of its subcontractors and suppliers. The Contractor will not be permitted to perform any physical work on the Project without the approval of the required submittals. Failure to properly plan for long lead items within the Contract schedule will not be justification for additional construction time.

It is recommended that the Contractor identify early in the construction sequencing process the subcontractors and suppliers associated with long lead-time items and submit accordingly upon Award.

The Engineer will conduct a pre-coordination meeting at the Project Site before the Contractor prepares submittals under the following CSI Division 05 Sections:

1. Section 051200, "Structural Steel Framing."
2. Section 052100, "Steel Joist Framing."
3. Section 053100, "Steel Decking."
4. Section 055000, "Metal Fabrications."

NOTICE TO CONTRACTOR – SOLE SOURCE PRODUCTS

For operational purposes, the Department has determined the need to sole source products specified in the following Contract provisions (including specific CSI-formatted Specifications contained within a particular Special Provision):

1. Automated Fuel Management System: Division 13 Section 132160, "Installation of New Fuel Facility."
2. HVAC Controls: Division 23 Section 230900, "Instrumentation and Control for HVAC."
3. Voice and Data Jacks: Division 27 Section 270000, "Premises Telephone Wiring."

No "Or Equals" will be permitted. Said products shall be installed only by their factory authorized installer or service representative. The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS

The Contractor shall submit manufacturer certification letters for all materials specified in the following Contract provisions (including CSI-formatted specifications contained within a particular special provision):

1. Division 07 Section 071113, "Bituminous Dampproofing."
2. Division 07 Section 071900, "Water Repellents."
3. Division 07 Section 072100, "Thermal Insulation."
4. Sealants: Division 07 Section 074213, "Metal Wall Panels."
5. Adhesives, Insulation, Cover Board, Expansion Joints: Division 07 Section 075419, "Polyvinyl Chloride (PVC) Roofing."
6. All products but Sheet Metals, Fasteners: Division 07 Section 076200, "Sheet Metal Flashing and Trim."
7. All products but Metals, Fasteners: Division 07 Section 077100, "Roof Specialties."
8. Felt, Gaskets, Sealants, Roof Hatch Insulation: Division 07 Section 077200, "Roof Accessories."
9. Division 07 Section 078413, "Penetration Firestopping."
10. Division 07 Section 078446, "Fire-Resistive Joint Systems."
11. Division 07 Section 079200, "Joint Sealants."
12. Division 08 Section 081113, "Hollow Metal Doors and Frames."
13. Division 08 Section 083323, "Overhead Coiling Doors."
14. Division 08 Section 083613, "Sectional Doors."
15. Glazing Strips and Sealants: Division 08 Section 085113, "Aluminum Windows."
16. Glazing Strips and Sealants: Division 08 Section 085123, "Steel Windows."
17. Glazing Tapes and Sealants: Division 08 Section 088000, "Glazing."
18. Division 09 Section 093000, "Tiling."
19. Division 09 Section 095123, "Acoustical Tile Ceilings."
20. Division 09 Section 096513, "Resilient Base and Accessories."
21. Division 09 Section 096519, "Resilient Tile Flooring."
22. Tapes and Adhesives: Division 10 Section 101400, "Signage."
23. Adhesives: Division 12 Section 123530, "Casework."
24. Division 13 Section 133419, "Metal Building Systems."
25. Gaskets: Division 21 Section 211313, "Wet-Pipe Sprinkler Systems."
26. Division 22 Section 220523, "General-Duty Valves for Plumbing Piping."
27. Division 22 Section 220719, "Plumbing Piping Insulation."
28. Water Heaters: Division 22 Section 223400, "Fuel-Fired, Domestic Water Heaters."
29. Division 23 Section 230523, "General-Duty Valves for HVAC Piping."
30. Division 23 Section 230713, "Duct Insulation."
31. Division 23 Section 230719, "HVAC Piping Insulation."
32. Gaskets: Division 23 Section 231123, "Facility Natural-Gas Piping."
33. Gaskets: Division 23 Section 232113, "Hydronic Piping."
34. Sealants: Division 23 Section 233113, "Metal Ducts."

35. Flexible Connectors and Ducts: Division 23 Section 233300, “Air Duct Accessories.”
36. Division 23 Section 235100, “Breechings, Chimneys, and Stacks.”
37. Division 23 Section 235223, “Cast-Iron Boilers.”
38. Division 23 Section 237413, “Package, Outdoor, Central-Station Air Handling Units.”
39. Division 26 Section 260519, “Low-Voltage Electrical Power Conductors and Cables.”
40. Division 26 Section 260544, “Sleeves and Sleeve Seals for Electrical Raceways and Cabling.”

The above list may not be all-inclusive and does not relieve the Contractor from its responsibility to provide manufacturer certification letters that are required under other Contract provisions. Furthermore, the Department may at any time require the Contractor to submit manufacturer certification letters proving that other materials do not contain asbestos.

NOTICE TO CONTRACTOR – PRE-INSTALLATION MEETINGS

The Engineer will conduct a pre-installation meeting at the Project Site before each of the following construction activities:

1. Predemolition: Form 818 Article 1.20-1.08.03 – Prosecution of Work, subsection 5 – Selective Demolition.
2. Concrete: CSI Division 3 Section 033000, "Cast-In-Place Concrete."
3. Siding: CSI Division 7 Section 074213, "Metal Wall Panels."
4. Roofing: CSI Division 7 Section 075419, "Polyvinyl-Chloride (PVC) Roofing."
5. Roofing: CSI Division 7 Section 077100, "Roof Specialties."
6. Flooring: CSI Division 9 Section 094020, "Polyacrylate Modified Terrazzo."
7. Fuel Facility: CSI Division 13 Section 132160, "Installation of New Fuel Facility."
8. Building, Roofing, Walls: Division 13 Section 133419, "Metal Building Systems."
9. Testing, Adjusting, and Balancing: CSI Division 23 Section 230593, "Testing, Adjusting, and Balancing for HVAC."
10. Building Automation System: CSI Division 23 Section 230900, "Instrumentation and Control for HVAC."

The above list may not be all-inclusive and does not relieve the Contractor from its responsibility to provide pre-installation meetings that are required under other Contract provisions.

NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS

General: The list of special provisions (including CSI-formatted specifications) in the Table below may not be all-inclusive and does not relieve the Contractor from its responsibility to provide spare parts, operation and maintenance manuals, training, and warranties that are required under other Contract provisions.

Spare Parts: The Contractor shall deliver spare parts on products listed in the Table below to the Project Site.

Operation and Maintenance Manuals: Submit in accordance with Form 818 Article 1.20-1.08.14. The Designer and the Owner (Mr. David A. Hartley, Office of Property and Facilities Services) will review the manuals for conformance to the Contract.

Product Maintenance Manual: The Contractor shall provide complete information in the materials and finishes manual on products listed in the Table below.

Equipment and Systems Maintenance Manuals: The Contractor shall provide complete information in the equipment and systems manual on products listed in the Table below.

Training: The Contractor shall provide training on products listed in the Table below.

Warranties: Submit in accordance with Form 818 Article 1.20-1.06.08. The Designer and the Owner will review the warranties for conformance to the Contract.

The Contractor shall provide special warranties on products and installations listed in the Table. It is the contractor's responsibility to confirm the table is complete and conforms with all specifications.

TABLE

Special Provision (including CSI-formatted Specifications)	Warranties	Spare Parts	Training	Operation and Maintenance Manuals
CSI Section 074213, "Metal Wall Panels"	X			X
CSI Section 075419, "Polyvinyl Chloride (PVC) Roofing"	X			X
CSI Section 083313, "Coiling Counter Fire Doors"			X	X
CSI Section 083323, "Overhead Coiling Doors"	X		X	X
CSI Section 083613, "Sectional Doors"	X		X	X
CSI Section 085113, "Aluminum Windows"	X			X
CSI Section 087100, "Door Hardware"				X
CSI Section 088000, "Glazing"	X			

Special Provision (including CSI-formatted Specifications)	Warranties	Spare Parts	Training	Operation and Maintenance Manuals
CSI Section 093000, “Tiling”		X		
CSI Section 094020, Polyacrylate Modified Terrazzo”				X
CSI Section 095123, “Acoustical Tile Ceilings”		X		
CSI Section 096513, “Resilient Base and Accessories”		X		
CSI Section 096519, “Resilient Tile Flooring”		X		X
CSI Section 105113, “Metal Lockers”				X
CSI Section 111000, Vehicle Service Equipment”	X		X	X
CSI Section 111400, Vehicle Washing Equipment”			X	X
CSI Section 113100, “Appliances”				X
CSI Section 123530, “Casework”				X
CSI Section 132160, “Installation of New Fuel Facility”	X		X	X
CSI Section 132180, “Tank Monitoring System”			X	X
CSI Section 133419, “Metal Building Systems”	X			X
CSI Section 144500, “Vehicle Lifts”	X	X	X	X
CSI Section 146010, “Hoists and Cranes”	X	X	X	X
CSI Section 211313, “Wet-Pipe Sprinkler Systems”		X	X	X
CSI Section 220553, “Identification for Plumbing Piping and Equipment”				X
CSI Section 221119, “Domestic Water Piping Specialties”		X		X
CSI Section 221123, “Domestic Water Pumps”			X	X
CSI Section 221325, “Oil-Water Separator”	X			X
CSI Section 221513, “General-Service Compressed Air Piping”				X
CSI Section 221519, “General-Service Packaged Air Compressors and Receivers”	X	X	X	X
CSI Section 223400, “Fuel-Fired Domestic Water Heaters”	X		X	X
CSI Section 224213, “Commercial Water Closets and Urinals”		X		X
CSI Section 224216, “Commercial Lavatories and Sinks”		X		X
CSI Section 224223, “Commercial Showers”		X		X
CSI Section 224233, “Wash Fountains”		X		X
CSI Section 224500, “Emergency Plumbing Fixtures”				X
CSI Section 224716, “Pressure Water Coolers”				X
CSI Section 230553, “Identification for HVAC Piping and Equipment”				X

Special Provision (including CSI-formatted Specifications)	Warranties	Spare Parts	Training	Operation and Maintenance Manuals
CSI Section 230900, “Instrumentation and Control for HVAC”		X	X	X
CSI Section 231123, “Facility Natural-Gas Piping”				X
CSI Section 232116, “Hydronic Piping Specialties”				X
CSI Section 232123, “Hydronic Pumps”		X	X	X
CSI Section 233300, “Air Duct Accessories”		X		
CSI Section 233423, “HVAC Power Ventilators”		X	X	X
CSI Section 233823, “Industrial Ventilating Equipment”			X	X
CSI Section 235223, “Cast-Iron Boilers”	X		X	X
CSI Section 237413, “Package, Outdoor, Central-Station Air Handling Units”	X	X	X	X
CSI Section 238123, “Computer Room Air-Conditioners”	X	X	X	X
CSI Section 238216, “Air Coils”				X
CSI Section 238233, “Convectors”				X
CSI Section 238236, “Finned-Tube Radiation Heaters”				X
CSI Section 238239, “Unit Heaters”			X	X
CSI Section 238316, “Radiant-Heating Hydronic Piping”			X	X
CSI Section 260572, “Overcurrent Protective Device Short-Circuit Study”			X	
CSI Section 260574, “Overcurrent Protective Device Arc-Flash Study”			X	X
CSI Section 260923, “Lighting Control Devices”				X
CSI Section 262416, “Panelboards”		X		
CSI Section 262813, “Fuses”		X		
CSI Section 263213, “Engine Generators”	X	X	X	X
CSI Section 263600, “Transfer Switches”	X		X	
CSI Section 264313, “Surge Suppression for Low-Voltage Electrical Power Circuits”	X		X	X
CSI Section 265119, “LED Interior Lighting”	X	X		X
CSI Section 265613, “Lighting Poles and Standards”	X			
CSI Section 265619, “LED Exterior Lighting”	X	X		X
CSI Section 275116, “Public Address Systems”			X	X
CSI Section 282300, “Video Surveillance”	X		X	X
CSI Section 283111, “Digital, Addressable Fire-Alarm System”	X	X	X	X

NOTICE TO CONTRACTOR – UTILITY SERVICE CONNECTIONS AND RELOCATIONS

The electric, telephone, cable, gas, water (including fire protection), and sewer services to the Project Site require service connections and/or relocations from/to the applicable utility company's facilities. Utility service connection relocations and installations to the point of the utility service are included as shown and described within the Contract.

Unless otherwise noted, the Contractor is responsible for notifying each utility company a minimum of 4 weeks' notice prior to the need for the utility to perform any work, and for coordinating the service connection and/or relocation requirements with the utility company. The Contractor shall coordinate with the following utility companies:

Water:	Putnam Water Department
Sewer:	Town of Putnam Water and Sewer Department
Gas:	Eversource Energy - Gas Distribution
Electric:	Eversource Energy - Electric Distribution
Telephone:	Frontier Communications of Connecticut
Cable:	Atlantic Broadband

Where known, utility company representative names are identified within the Contract.

Item No. 1700001A – Service Connections (Estimated Cost) is included in the Contract to reimburse each utility for their work that is required to support Contract work. Refer to the CSI Specification Sections referenced below for additional information in this regard.

Water:	Item No. 1301307A – 2" Copper Pipe (Type K).
	Item No. 1301082A - 8" Ductile Iron Pipe (Water Main).
Sewer:	CSI Section 307000, "Sanitary/Drainage."
Gas:	CSI Section 231123, "Facility Natural-Gas Piping."
Electric:	CSI Section 262713, "Electricity Metering."
Telephone:	CSI Section 270000, "Premises Telephone Wiring."
Cable:	CSI Section 270000, "Premises Telephone Wiring."

NOTICE TO CONTRACTOR - COMPASS SUBMITTALS

Upon execution of the Contract, the Contractor acknowledges and agrees that contractual submittals for this Project shall be submitted and handled through the Department's project management system, COMPASS.

Contractor submittals including, but not limited to, Shop Drawings, Working Drawings, Product Data, RFIs, and RFCs shall be generated and delivered by the Contractor in accordance with the Department's COMPASS Contractor's User Manual. The administering District office will inform the Contractor of other deliverables required to be similarly submitted.

Access credentials for COMPASS will be provided free of charge to the Contractor.

The Department shall not be held responsible for delays, lack of processing or responses to submittals that do not follow the specified guidelines in the COMPASS Contractor's User Manual.

NOTICE TO CONTRACTOR - PORTLAND CEMENT CONCRETE (PCC) MIX CLASSIFICATIONS

SECTIONS 6.01 and M.03 MIX CLASSIFICATION EQUIVALENCY

Sections 6.01 *Concrete for Structures* and M.03 *Portland Cement Concrete* have been revised to reflect changes to item names and nomenclature for standard Portland cement concrete (PCC) mix classifications. Special Provisions, plan sheets and select pay items in this Contract may not reflect this change. Refer to the Concrete Mix Classification Equivalency Table below to associate the Concrete Mix Classifications with Former Mix Classifications that may be present elsewhere in the Contract.

Concrete Mix Classification Equivalency Table

New Mix Classification (Class PCCXXXYZ[1])	Former Mix Classification
Class PCC03340	Class "A"
Class PCC03360	Class "C"
Class PCC04460[2]	Class "F"
Class PCC04462[2]	High Performance Concrete
Class PCC04481, PCC05581	Class "S"

Table Notes:

1. See Table M.03.02-1, Standard Portland Cement Concrete Mixes, for the new Mix Classification naming convention.
2. Class PCC04462 (formerly Class "HP1" Concrete; also called low permeability concrete) is to be used for the following cast-in-place bridge components: decks, bridge sidewalks, and bridge parapets.

Where called for in the Contract, **Low Permeability Concrete** shall be used, as specified in Sections 6.01 and M.03. Please pay special attention to the requirements for Class PCC04462, including:

- Submittal of a mix design developed by the Contractor and a concrete supplier **at least 90 days prior to placing the concrete**
- Testing and trial placement of the concrete mix is to be developed and discussed with the Department

The Department will not consider any requests for change to eliminate the use of Low Permeability Concrete on this Project.

NOTICE TO CONTRACTOR - ARCHITECTURAL AND INDUSTRIAL MAINTENANCE COATINGS

This Contract includes the application of materials subject to the Volatile Organic Compounds (VOC) content limits stated in the Regulations of Connecticut State Agencies (RCSA) Sections 22a-174-41 and -41a. All architectural and industrial maintenance (AIM) coatings and applications of such coatings must comply with these regulations.

The Contractor shall submit a Material Safety Data Sheet/Safety Data Sheet or Product Technical Data Sheet developed by the manufacturer of each material that may be subject to the Regulations. The submittal must verify both the type of AIM and its VOC Content. VOC content shall be determined based on the formulation data supplied by the materials manufacturer.

The Contractor may only use AIM coatings that contain VOCs below the respective coating category Phase II limits specified in Table 1 if either:

a) the coating was manufactured on or after May 1, 2018, **or**
b) the coating is being applied after April 30, 2021.

The Contractor may use AIM coatings that contain VOCs exceeding the respective coating category Phase II limits specified in Table 1 only if all of the following four conditions are met:

a) the coating is being applied on or before April 30, 2021,
b) the coating contains VOCs below the applicable Phase I limits specified in Table 1,
c) the coating was manufactured prior to May 1, 2018, **and**
d) the coating container(s) are dated (or date coded) as such.

For any coating that is not categorized within Table 1, the Contractor shall classify the coating as follows and apply corresponding limits in Table 1.

- Registers gloss <15 on an 85-degree meter or <5 on a 60-degree meter) – Flat Coating,
- Registers gloss of ≥15 on an 85-degree meter and ≥5on a 60-degree meter) - Nonflat Coating,
- Registers gloss of ≥70 on a 60-degree meter - Nonflat-High Gloss Coating.

The Contractor must close all containers of coating and solvent when not in use.

Coating container labels must display the date the coating was manufactured, the manufacturer's recommendation regarding thinning with solvent, and the coating's VOC content in grams per liter (g/L) of coating. Certain coating categories as noted in Table 1 have additional labeling requirements.

The Contractor may add additional solvent to a coating only if such addition does not cause the coating to exceed the applicable VOC limit specified Table 1. The Contractor must adhere to type(s) of solvent and maximum amount of solvent recommended by coating manufacturer. VOC content of a thinned coating shall be the VOC content as listed by the manufacturer after thinning in accordance with its recommendation.

TABLE 1		
Coating Category	**Phase I**	**Phase II**
	manufactured prior to May 1, 2018 VOC content limit (g/L)	**manufactured on or after May 1, 2018 VOC content limit (g/L)**
Aluminum roof coating	---[1]	450
Antenna coating	530	---[1]
Antifouling coating	400	---[1]
Basement specialty coating	---[1]	400
Bituminous roof coating	300	270
Bituminous roof primer	350	350
Bond breaker	350	350
Calcimine recoater	475	475
Clear wood coating - Clear brushing lacquer[2]	680	275
Clear wood coating - Lacquer[2,3]	550	275
Clear wood coating - Sanding sealer[2,4]	350	275
Clear wood coating - Varnish[2]	350	275
Concrete curing compound	350	350
Concrete or masonry sealer/ Waterproofing concrete or masonry sealer	400	100
Concrete surface retarder	780	780
Conjugated oil varnish	---[1]	450
Conversion varnish	725	725
Driveway sealer	---[1]	50
Dry fog coating	400	150
Faux finishing coating[2]	350	350
Fire resistive coating	350	350
Fire retardant coating - Clear	650	---[1]
Fire retardant coating - Opaque	350	---[1]
Flat coating	100	50
Floor coating	250	100
Flow coating	420	---[1]
Form-release compound	250	250
Graphic arts coating (sign paint)	500	500
High temperature coating	420	420
Impacted immersion coating	780	780
Industrial maintenance coating[2]	340	250
Industrial maintenance coating	340	250
Low solids coating	120	120
Magnesite cement coating	450	450
Mastic texture coating	300	100
Metallic pigmented coating	500	500

TABLE 1		
Coating Category	**Phase I**	**Phase II**
	manufactured prior to May 1, 2018 VOC content limit (g/L)	**manufactured on or after May 1, 2018 VOC content limit (g/L)**
Multi-color coating	250	250
Nonflat coating	150	100
Nonflat high gloss coating[2]	250	150
Nuclear coating	450	450
Pre-treatment wash primer	420	420
Primer, sealer and undercoater	200	100
Quick-dry enamel	250	---[1]
Quick-dry primer, sealer and undercoater	200	---[1]
Reactive penetrating carbonate stone sealer[2]	---[1]	500
Reactive penetrating sealer[2]	---[1]	350
Recycled coating	250	250
Roof coating	250	250
Rust preventive coating[2]	400	250
Shellac Clear	730	730
Shellac Opaque	550	550
Specialty primer, sealer and undercoater[2]	350	100
Stain	250	250
Stone consolidant[2]	---[1]	450
Swimming pool coating	340	340
Thermoplastic rubber coating and mastic	550	550
Traffic marking coating	150	100
Traffic marking coating	150	100
Tub and tile refinish	---[1]	420
Waterproofing membrane	---[1]	250
Waterproofing sealer	250	---[1]
Wood coating[2]	---[1]	275
Wood preservative	350	350
Zinc-rich primer[2]	---[1]	340

1 Classify as follows and apply corresponding limits in Table 1.

- Registers gloss <15 on an 85-degree meter or <5 on a 60-degree meter) – Flat Coating,
- Registers gloss of ≥15 on an 85-degree meter and ≥5on a 60-degree meter) – Nonflat Coating
- Registers gloss of ≥70 on a 60-degree meter – Nonflat-High Gloss Coating

2 Container must be appropriately labeled. See RCSA 22a-174-41a

3 "Clear Wood Coating – Lacquer" includes lacquer sanding sealer

4 "Clear Wood Coating - Sanding Sealer" does not include lacquer sanding sealer

-END-

March 1, 2020

NOTICE TO CONTRACTOR - FORM 818 ARTICLE 1.05.19 – FIELD ERECTOR PREQUALIFICATION

The following requirements will be incorporated into 1.05 – Control of the Work to be included in Contracts as of the January 2021 Supplements to the Standard Specifications, Form 818:

1.05.19—Field Erector Prequalification: Contractors erecting structural steel for Department projects are required to possess the appropriate AISC Certified Steel Erector (CSE) Certification as follows.

1. For Department bridge and large sign installation projects, Contractors are required to possess the certification stated in the Contract. All Contractors performing structural steel work on new construction or rehabilitation work of bridges will be required to possess CSE certification with a Bridge Erection Endorsement.
2. For Department Facilities projects, CSE certification for Steel-Framed Buildings is required when erecting steel on both new and existing Facilities projects.

Those affected shall plan accordingly.

NOTICE TO CONTRACTOR - 9.49 – FURNISHING, PLANTING AND MULCHING TREES, SHRUBS, VINES AND GROUND COVER PLANTS

The Contractor is hereby notified that Section 9.49 of the *Standard Specifications* in Form 818 has been revised as follows:

1. The Contractor must secure an Encroachment Permit to work in the plantings area to satisfy the one year warranty requirements.
2. The Encroachment Permit requires a Permit Bond.
3. The Contractor is responsible for the One-Year Establishment Period, 1 year from the date of final acceptance to the satisfactory completion of the planting activities.
4. The Contractor shall secure a Permit Bond in the amount of $10,000 or 20% of the sum of all plant items, whichever is greater, along with an Encroachment Permit from the Department in order to guarantee the One-Year Establishment Period.

See Article 9.49.03-15 for more information.

NOTICE TO CONTRACTOR - ELECTRONIC ENGINEERING DATA (EED)

The EED is an assembly of engineering data files that were used to produce the Contract plans.

Electronic Engineering Data (EED) is provided for information purposes only. In case of conflict between the EED and the Contract plans and specifications, the contract plans and specifications shall govern. The EED has been reviewed by the Department for quality control purposes, but it is the Contractor's responsibility to build the Project per the contract plans and specifications.

The EED is being provided to the Engineer for GPS/RTS inspection. The Contractor may use the EED to assist in bidding, layout and Automated Machine Control/Guidance.

The EED includes geospatially-correct 2D CAD files and may include horizontal and vertical alignment data files, 3D surface model files (break-line features and triangles) and a preference file. The data is being provided in two formats:

- Native Format
  - Bentley MicroStation CAD files (dgn)
  - Bentley SS2 InRoads Alignment Files (alg)
  - Bentley SS2 InRoads Digital Terrain Models (dtm)
  - Bentley SS2 InRoads Preference File (xin)
- Converted Format (for use in GPS/RTS Site equipment)
  - AutoCAD CAD files (dxf)
  - Alignment files (xml)
  - Surface Models (xml)

For a complete list of EED files, see the EED file manifest (PDF) located in the EED_0115-0121.zip file (0115-0121 is the project number) which is posted with the contract PS&E's on the State Contracting portal.

NOTICE TO CONTRACTOR - 1.05 CONTROL OF THE WORK

1.05.03 – CONFORMITY WITH PLANS AND SPECIFICATIONS (INCLUDING QUALITY CONTROL)

The Contractor is hereby notified that a Quality Management Plan will be required for this Project in accordance with Standard Specifications Article 1.05.03 – Conformity with Plans and Specifications (including Quality Control).

NOTICE TO CONTRACTOR - QUALITY CONTROL PROGRAM

ITEM #0969054A CONTRACTOR QUALITY CONTROL PROGRAM LEVEL 1

This Contract includes the above-noted item and special provision for Contractor Quality Control Program, developed to supplement Article 1.05.03 of the standard specifications.

A minimum lump sum bid amount is included within the special provision.

The Contractor must be aware that the special provision requires that a Quality Control Manager (QCM) be proposed to the Department within thirty (30) days after Contract Award and that the written QC Program be submitted to the Department within forty-five (45) days after Contract Award.

The Contractor must also be aware of the staffing, inspection, reporting and all other requirements of the special provision.

SECTION 1.02 - PROPOSAL REQUIREMENTS AND CONDITIONS

1.02.01—Contract Bidding and Award:

After the first sentence of the third paragraph, add the Following:

In accordance with the provisions of the Construction Contract Bidding and Award Manual, bidders must be prequalified for **Group No. 25B Vertical Construction - Intermediate**, to be eligible to bid on this project. Bidders that are not prequalified for this work classification will not be approved to bid on this project.

SECTION 1.03 - AWARD AND EXECUTION OF CONTRACT

Article 1.03.08 - Notice to Proceed and Commencement of Work:

Change the first paragraph to read as follows:

> "The Contractor shall commence and proceed with the Contract work on the date specified in a written notice to proceed issued by the Engineer to the Contractor. The date specified will be no later than 45 calendar days after the date of the execution of the Contract by the Department".

SECTION 1.07 – LEGAL RELATIONS AND RESPONSIBILITIES

Delete Article 1.07.07 in its entirety and replace it with the following:

1.07.07—Safety and Public Convenience: The Contractor shall conduct the Project work at all times in such a manner as to ensure the least possible obstruction to traffic. In a manner acceptable to the Engineer, the Contractor shall provide for the convenience and interests of the general public; the traveling public; parties residing along or adjacent to the highway or Project Site; and parties owning, occupying or using property adjacent to the Project Site, such as commuters, workers, tenants, lessors and operating agencies.

Notwithstanding any other Contract provision, the Contractor shall not close to normal pedestrian or vehicular traffic any section of road, access drive, parking lot, sidewalk, station platform, railroad track, bus stop, runway, taxiway, occupied space within a Site, or occupied space within a building, except with the written permission of the Engineer.

All equipment, materials, equipment or material storage areas, and work areas must be placed, located, and used in ways that do not create a hazard to people or property, especially in areas open to public pedestrian or vehicular traffic. All equipment and materials shall be placed or stored in such a way and in such locations as will not create a hazard to the traveling public or reduce sight lines. In an area unprotected by barriers or other means, equipment and materials must not be stored within 30 feet of any traveled way.

The Contractor must always erect barriers and warning signs between any of its work or storage areas and any area open to public, pedestrian, or vehicular traffic. Such barriers and signs must comply with all laws and regulations, including any applicable codes.

The Contractor must arrange for temporary lighting, snow and ice removal, security against vandalism and theft, and protection against excessive precipitation runoff within its Project work and storage areas, and within other areas specifically designated in the Contract.

In addition to meeting the requirements of Section 9.71, the Contractor shall take all precautions necessary and reasonable for the protection of all persons, including, but not limited to, employees of the Contractor or the Department, and for the protection of property, until the Engineer notifies the Contractor in writing that the Project or the pertinent portion of the Project has been completed to the Engineer's satisfaction.

The Contractor shall comply with the safety provisions of applicable laws, including building and construction codes and the latest edition of the CFR. The Contractor must make available for reference in its field office, throughout the duration of the Project, a copy of the latest edition and all supplements of the CFR pertaining to OSHA.

The Contractor shall make available to the Contractor's employees, subcontractors, the Engineer, and the public, all information pursuant to OSHA 29 CFR Part 1926.59 and The Hazard Communication Standard 29 CFR 1910.1200, and shall also maintain a file on each job site containing all MSDS for products in use at the Project. These MSDS shall be made available to the Engineer upon request.

The Contractor shall observe all rules and regulations of the Federal, State, and local health officials. Attention is directed to Federal, State, and local laws, rules, and regulations concerning construction safety and health standards. The Contractor shall not require any worker to work in surroundings or under conditions that are unsanitary, hazardous, or dangerous to the worker's health or safety.

Safety Plan: Before starting work on the Project, the Contractor shall submit to the Engineer a written Safety and Health Plan (hereinafter referred to as the "Plan"). The Plan shall meet or exceed the minimum requirements of this Subsection and any applicable State or Federal regulations.

The Plan shall apply to any work under the Contract whether such work is performed, by way of example and not limitation, by the Contractor's forces, subcontractors, suppliers, or fabricators.

The Plan shall be prepared by the Contractor and submitted to the Engineer for review before the actual start of work on the Project. Within ten (10) calendar days of receipt, the Engineer will determine whether or not the Plan meets the requirements of this Specification. If the Plan does not meet the requirements of this Specification, it will be returned for revision. Work on the Project may not proceed until the Engineer has accepted the Plan. Nothing herein shall be construed, however, to relieve the Contractor from responsibility for the prosecution of the Project.

The Plan shall conform to the following general format:

1. **General Introduction**.
   a. **Description.** The general introduction of the Plan shall include a statement by the Contractor describing its commitment to maintain a safe work environment for its employees, Department representatives, and the public. Implementation procedures and company policies relative to safety shall be summarized or referenced in the Plan.
      i. The Plan shall include the names, addresses, and telephone numbers of the Contractor's Project Manager, Project superintendent and/or its designee for safety oversight, all competent persons, and the traffic control coordinator. Any changes to the safety management and oversight for the Project shall be promptly communicated to all concerned.
      ii. The Plan shall provide guidelines for protecting all personnel from hazards associated with Project operations and activities.

iii. The Plan shall establish the policies and procedures that are necessary for the Project to be in compliance with the requirements of OSHA and other State and Federal regulatory agencies with jurisdiction, rules, regulations, standards, or guidelines in effect at the time the work is in progress.

b. Responsibility, Identification of Personnel, and Certifications. The Contractor is solely responsible for creating, implementing, and monitoring the Plan.

i. The Contractor shall identify and designate on-site supervisory level personnel who shall be responsible for implementing and monitoring the Plan at all times throughout the duration of the Project and shall have authority to take prompt corrective measures to eliminate hazards including the ability to stop work activities.

ii. Documentation of training provided to the on-site supervisory level personnel shall be included as part of the Plan.

iii. For any work activities wherein the Contractor has identified a competent person as defined by OSHA, that person shall be capable of identifying existing and predictable hazards and have the authority to take prompt corrective measures to eliminate the hazards, including the ability to stop work activities.

iv. Documentation of the qualifications of such competent persons identified, including any certifications received, shall be included as part of the Plan.

v. The Contractor shall further identify the qualified safety professional responsible for developing the Plan and shall provide that person's qualifications for developing the Plan which shall include, but not be limited to, education, training, certifications, and experience in developing this type of Plan.

vi. The Plan shall contain a certification executed by the qualified safety professional that developed the Plan, stating that the Plan complies with OSHA and other applicable State and Federal regulatory agencies with jurisdiction, rules, regulations, standards, or guidelines in effect at the time the work is in progress.

2. Elements of the Plan. The Plan shall address, but not be limited to, the following elements:

a. Management Safety Policy and Implementation Statement.

i. The Plan shall describe in detail the means by which the Contractor shall implement and monitor the Plan. Implementation and monitoring shall also mean that the Plan shall be a document with provision for change to update the Plan with new information on a yearly basis at a minimum and shall include new practices or procedures, changing site and environmental conditions, or other situations that could adversely affect site personnel. The Plan shall provide guidelines for protecting all personnel from hazards associated with Project operations and activities.

b. Emergency Telephone Numbers.

c. Personnel Responsibilities.

i. Management responsibilities

ii. Responsibilities of Supervisor(s)

iii. Site safety officer(s) responsibilities

iv. Employee responsibilities
v. Competent person(s) as defined by OSHA responsibilities

d. Training.

i. Regulatory
ii. Documentation
iii. Site hazard assessment -Daily employee awareness of site operations

e. Safety Rules.

i. General safety rules
ii. Personal protective equipment
iii. Housekeeping

f. Safety Checklists.

i. Project safety-planning checklist
ii. Emergency plans and procedures checklist
iii. Documentation checklist
iv. Protective materials and equipment checklist

g. Traffic Control Coordinator Inspections.

i. Responsible person
ii. Frequency
iii. Documentation of actions taken

h. Record Keeping.

i. OSHA 200 log

i. Reporting.

i. Accident(s)
ii. On site
iii. Legal notice requirement
iv. Public liability
v. Property damage
vi. Department of Labor
vii. Hazard Communications

j. Additional Procedures for Project Specific Situations as Applicable.

i. Compressed gas cylinders
ii. Confined spaces
iii. Cranes
iv. Crystalline silica (stone, masonry, concrete, and brick dust)
v. Electrical
vi. Equipment operators
vii. Fall protection
viii. Hand and power tools
ix. Hearing conservation
x. Highway safety
xi. Lead health and safety plan
xii. Lock out/tag out
xiii. Materials handling, storage, use, and disposal
xiv. Areas of environmental concern

xv. Night work
xvi. Personal protective equipment
xvii. Project entry and exit
xviii. Respiratory protection
xix. Sanitation
xx. Signs, signals, and barricades
xxi. Subcontractors
xxii. Trenching

3. **Appendix for Environmental Health and Safety Plan (HASP).** If environmental hazards are identified in the Contract, an Environmental HASP shall be included in an appendix to the Plan, or in a separate document. References to any Environmental HASP shall be included within the Plan, where appropriate.

The Plan shall be kept on the site and shall apply and be available to all workers and all other authorized persons entering the work site. Copies of all updates to the Plan shall be promptly supplied to the Engineer.

If at any time during the Project the Engineer determines that the Contractor is not complying with the requirements of this provision or the updated Plan, the Contractor shall correct such deficiencies immediately. Failure to remediate such deficiencies may result in suspension of the Contractor's operations until the deficiencies have been corrected. Suspensions ordered due to safety deficiencies will not be considered compensable or excusable delays.

The Contractor is responsible for implementation of the Plan. Pursuant to Article 1.07.10, the Contractor shall indemnify, and save harmless the State from any and all liability related to the Plan in proportion to the extent that the Contractor is held liable for same by an arbiter of competent jurisdiction.

The Contractor shall allow onto the Project site any inspector of OSHA or other legally responsible agency involved in safety and health administration upon presentation of proper credentials, without delay and without the presentation of an inspection warrant.

SECTION 1.08 - PROSECUTION AND PROGRESS

Article 1.08.04 - Limitation of Operations - Add the following:

In order to provide for traffic operations as outlined in the Special Provision "Maintenance and Protection of Traffic," the Contractor will not be permitted to perform any work which will interfere with the described traffic operations on all project roadways as follows:

Rt 12 (Killingly Ave.) and Industrial Park Rd.

Monday through Friday between 6:00 a.m. and 9:00 a.m. & between 3:00 p.m. and 6:00 p.m.
Saturday and Sunday between 10:00 a.m. and 6:00 p.m.

Article 1.08.07 - Determination of Contract Time:

Delete the second, third and fourth paragraphs and replace them with the following:

When the contract time is on a calendar day basis, it shall be the number of consecutive calendar days stated in the contract, INCLUDING the time period from December 1 through March 31 of each year. The contract time will begin on the effective date of the Engineer's order to commence work, and it will be computed on a consecutive day basis, including all Saturdays, Sundays, Holidays, and non-work days.

1.08.08 - Extension of Time:

Delete the sixth paragraph, "If an approved extension of Contract time…. the following April 1".

Article 1.08.09 - Failure to Complete Work on Time:

Delete the second paragraph, "If the last day...the project is substantially completed" *and replace it with* "Liquidated damages as specified in the Contract shall be assessed against the Contractor per calendar day from that day until the date on which the project is substantially completed.".

SECTION 1.10 ENVIRONMENTAL COMPLIANCE

In Article 1.10.03--Water Pollution Control:
BEST MANAGEMENT PRACTICES

Add the following after Required Best Management Practices Number 14:

15. The Contractor is hereby notified that the location of the Project occurs within a public watershed, well head protection area, aquifer protection area (APA), or sole source aquifer (SSA). The Contractor is hereby notified that the location of Project No. 34-350 occurs within one of these sensitive areas. The protected areas encompass the area of contribution and recharge for the protected resource, as depicted on the graphical map. Please note that the Office of Environmental Planning will provide the graphical map to the District after the Project has been awarded as this information is considered proprietary. As a result of this location, special requirements must be followed for cleaning machinery, storage of materials, and servicing/fueling equipment.

    a. All Contractors and their employees must be informed of the sensitive area that they are working in. No pollutants may be discharged that could have adverse effects on the public drinking water supply. Any fuel or other hazardous chemical spills must be reported immediately to the DEEP Oil and Chemical Spills Unit at (860) 424-3338, the Department of Public Health's Drinking Water Division at 860-509-7333, and Aquarion Water Company at 203-445-7310, **no exceptions**.

       When working within the Pootatuck SSA in *Newtown* or within the Pawcatuck *SSA in North Stonington which also encompasses areas in Sterling, Stonington* and *Voluntown*, Mr. Jeff Butensky from the Environmental Protection Agency (EPA) must be contacted at (617) 918-1665. Mr. Robert Adler from the EPA must also be contacted at (617) 918-1396, if a Project is near the Rhode Island state border.

    b. Contractors must adhere to specialized cleanup procedures while working within the watershed, well head protection area, APA or SSA. No cleaning of any machinery shall be performed within one hundred (100) feet of any water body within the sensitive area.

       i. Specifically for cleanup associated with pavers, material transfer vehicles (MTV) and concrete mixers, the Contractor must move the equipment off line onto a tarp. The tarp must be in an acceptable condition so as to prevent liquids and solids from passing through to the ground beneath, when the area is used for paving operations. The cleanup area shall have oil absorbent pads placed on the tarp. The equipment shall be cleaned over

the absorbent pads in a manner that will allow the pads to collect any liquids that are used for cleanup.

ii. Specifically for cleanup associated with dump trucks, a liquid tight five gallon pail shall be placed at each corner of the dump body below the lower hinges to capture any materials generated during the cleanup.

c. All materials generated during the cleanup procedures shall be removed off-site at the end of each day and disposed of in a manner consistent with all applicable laws and regulations. These materials shall not be buried outside of the roadway limits.

d. Servicing and fueling of equipment shall be conducted outside of a public watershed area, APA, SSA, and/or well head protection area.

i. If equipment cannot be serviced and refueled outside of the watershed area, well head protection area, APA, or SSA then the Contractor shall utilize the proper spoils handling areas that are identified on the plans.

ii. Servicing and fueling of equipment is not permitted within a 500 foot radius of a non-community well and within a 1000 foot radius of a community well.

iii. Any fuel and/or hazardous materials that must be kept within these sensitive areas during working hours shall be stored in an enclosed spill proof container.

iv. Spill containment systems must be utilized during fueling operations, and shall be manufactured by Sentry Lite Berms, Collapse-a-tainer, or approved equal. It shall have a minimum capacity of 80-gallons and shall be made of plastic or vinyl which is inert to all fuel types.

v. Fuel spill remediation kits shall be stored on-site so that spills may be contained and cleaned quickly.

e. Construction staging and laydown areas are prohibited within a watershed area, APA, SSA, and/or well head protection area. The Contractor shall submit to the Engineer the desired location of trailer(s), construction staging/laydown areas, containment systems, and sedimentation control systems for review and approval prior to the start of construction.

f. Millings may be re-used as asphalt material. Disposal of excess millings must be performed off-site in a manner consistent with all applicable laws and regulations. At no time can millings be dumped or buried outside of the roadway limits.

SECTION 1.20 – GENERAL CLAUSES FOR FACILITIES CONSTRUCTION

1.20-1.00 – Facilities Construction – General:

Add the following after the first paragraph:

"The Department has determined that this Project is Facilities Construction and therefore Section 1.20 applies."

[Retain the following for site work only projects when a Certificate of Compliance is not required but the Facilities Design Project Manager has determined Article 1.20 should still apply.]

Delete the first paragraph and replace with the following:

"The Department has determined that this Project is Facilities Construction and therefore Section 1.20 applies."

1.20-1.02.04— Facilities Construction – Knowledge of Applicable Laws:

Delete the 5th, 6th, and 7th paragraphs and replace with the following:

"The State Building Code, including latest Connecticut Supplements and Amendment, includes the following:
1. The 2015 International Building Code.
2. The 2015 International Plumbing Code.
3. The 2015 International Mechanical Code.
4. The 2015 International Existing Building Code.
5. The 2015 International Energy Conservation Code.
6. The 2017 NFPA 70 National Electrical Code.
7. The 2009 ICC/ANSI A117.1.

The State Fire Safety Code, including latest Connecticut Supplements and Amendment, includes the following:
1. The 2015 International Fire Code.
2. The 2015 NFPA 101 Life Safety Code.

The State Fire Safety Code, including latest Connecticut Supplements and Amendment, includes the following:
1. The 2015 NFPA 1."

1.20-1.05.02— Facilities Construction – Contractor Submittals:

Replace #1, #2, #3, #5, #6, #7, #8, #9, #10, and #11 with the following:

1. General: If the plans prepared by the Department do not show complete details, they will show the necessary dimensions and preliminary details, which when used along with the other Contract documents, will enable the Contractor to prepare submittals necessary to complete the Contract work.

The Contractor is required to prepare submittals as Portable Document Format (PDF) files using Bluebeam Revu.

The Contractor is also required to acquire and maintain access to the Department's COMPASS capital project delivery system. The minimum recommended internet speed is 25MB/sec. For reference, the Department's internet speed is 1 GB/sec.

The Contractor shall submit a request for COMPASS access to the Designer. The Department will provide Web-based access to the required number of Contractor users.

The entry/log-in procedure is described in the CT DOT COMPASS Contractor's User Manual.

2. Submittal Preparation and Processing: The Contractor shall:

(a) Coordinate preparation and processing of submittals with performance of construction activities;

(b) Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay;

(c) Coordinate each submittal with fabrication, purchasing, testing, delivery, and other submittals and related activities that require sequential activity;

(d) Provide separate submittal packages by submittal type as single or multi-page PDF's. Submittal types shall be WD, SD, CD, PD, PS, or QA as defined elsewhere. Incomplete submittal packages will be returned to the Contractor without being reviewed. Multi-page PDF's shall be limited to 250 MB; larger PDF files will need to be broken up and contained in the same submittal. "PDF Packages" shall not be submitted via COMPASS.

(e) Provide submittals for related elements of Project work for a concurrent review of all information.

The Contractor shall allow at least 21 calendar days for initial submittal review by the submittal reviewer, and allow additional time for such review if processing must be delayed to permit coordination with subsequent submittals. The submittal review time begins with the submittal upload. If a subsequent submittal is necessary, the Contractor shall allow at least 21 additional calendar days for processing each subsequent submittal. The submittal reviewer reserves the right to withhold action on a submittal if coordination with other submittals is necessary, until all related submittals are received. The submittal reviewer will promptly inform the Contractor when a submittal being processed must be delayed for such coordination.

The Contractor shall allow at least 28 calendar days for outside agency review of any submittal requiring their approval, including but not limited to the following: any utility, FTA, any railroad, DEEP, U.S. Coast Guard, Army Corps of Engineers, FM Global, and any Commissioning Authority.

The Engineer will not authorize an extension of Contract time because of the Contractor's failure to transmit submittals to the submittal reviewer or outside agencies sufficiently in advance of the work to permit processing.

The Contractor shall be limited to one acceptable submittal per product. Once a product has been accepted either as originally specified, or as an "Or Equal" to the product specified, the Contractor may elect to submit a subsequent product for consideration, but the Contractor shall be required to reimburse the Department for all costs associated with reviewing the subsequent

request.

The Contractor shall attach a Submittal Transmittal Form to the beginning of each PDF submittal. A blank Submittal Transmittal Form is located in the Appendix of the COMPASS Contractor's User Manual. This form will be used for the Contractor to digitally certify that "Having reviewed this submittal, I certify that it is complete, accurate, coordinated in all aspects of the item being submitted and conforms to the requirements of the Contract in all respects, including all Federal requirements such as "Buy America", except as otherwise noted." The digital certification process is detailed in the CT DOT COMPASS Contractor's User Manual.

3. Transmittal of Submittals: The digitally certified PDF submittal package shall be uploaded into COMPASS using the Submittals/Transmittals application. The submittal process is described in the CT DOT COMPASS Contractor's User Manual. The submittal reviewer will not act on submittals received in any other manner.

The Contractor shall use naming conventions described in the CT DOT COMPASS Contractor's User Manual unless otherwise directed by the Designer.

For those submittals or portions thereof returned to the Contractor with a "Revise and Resubmit" or "Rejected" workflow status, the Contractor shall use the "Replace File" function described in the CT DOT COMPASS Contractor's User Manual to properly upload the new version of the submittal document(s).

5. Working Drawings (Delegated Design Submittals) [WD]: When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and submit working drawings, signed, sealed and dated by a qualified Professional Engineer licensed to practice in the State of Connecticut, for review.

There will be no direct payment for furnishing any working drawings, procedures or supporting calculations, but the cost thereof shall be considered as included in the general cost of the work.

a. Working Drawings for Permanent Construction: The Contractor shall submit drawings to the Designer on 22 inch × 34 inch sheets with a border and title block similar to the Department standard. Drawings shall be searchable. The first drawing shall include the Contractor's designer's Professional Engineer's digital signature, meeting the requirements of Adobe's Certified Document Services (CDS) or Adobe's Approved Trusted List (AATL), and all other drawings shall include a watermark of the Professional Engineer's stamp in a common area of the border. Calculations, procedures and other supporting data may be submitted in an 8-1/2 inch × 11 inch format and shall be in a single PDF file. The first sheet of calculations shall include the Contractor's designer's Professional Engineer's digital signature, meeting the CDS or AATL requirements. Documents shall be named "Drawings," "Calculations," or "Supporting Documentation" as applicable. The Contractor's designer, who prepares the working drawings, shall secure and maintain at no direct cost to the State a Professional Liability Insurance Policy for errors and omissions in the minimum amount of $2,000,000 per error or omission. The Contractor's designer may elect to obtain a policy containing a maximum $250,000 deductible clause, but if the Contractor's designer should obtain a policy containing such a clause, they shall be liable to the extent of at least the deductible amount. The Contractor's designer shall obtain the appropriate and proper endorsement of its Professional Liability Policy to cover the indemnification clause in this Contract, as the same relates to negligent acts, errors or omissions in the Project work performed by them. The Contractor's designer shall continue this liability insurance coverage for a period of (i) 3 years from the date of acceptance of the work by the Engineer, as evidenced by a State of Connecticut, Department of Transportation form entitled

"Certificate of Acceptance of Work," issued to the Contractor; or (ii) 3 years after the termination of the Contract, whichever is earlier, subject to the continued commercial availability of such insurance. The Contractor shall supply to the Assistant District Engineer a certificate of insurance in accordance with 1.20-1.03.07 at the time that the working drawings for the Project are submitted.

b. Working Drawings for Temporary Construction: The Contractor shall submit drawings, calculations, procedures and other supporting data in a format acceptable to the Assistant District Engineer.

6. Shop Drawings [SD]: When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and submit shop drawings for review. Drawings shall be submitted on 22 inch × 34 inch sheets with an appropriate border and with a title block in the lower right-hand corner of each sheet. Drawings shall be searchable.

Shop Drawings consist of fabrication and installation drawings, roughing-in and setting drawings, schedules, patterns, templates and similar drawings, and wiring diagrams showing field-installed wiring, including power, signal, and control wiring. Standard information prepared without specific reference to the Project shall not be considered to be a Shop Drawing. Shop Drawings shall be project specific.

Shop drawings shall include the following information: Contract number, Project description, number and title of the drawing, date of drawing, revision number, name of Contractor and subcontractor submitting drawings, dimensions, identification of products, shop work manufacturing instructions, design calculations, statement of compliance with Contractual standards, notation of dimensions established by field measurement, notation of coordination requirements, relationship to adjoining construction clearly indicated, seal and signature of a professional engineer if specified, and any other information required by individual Contract provisions.

There will be no direct payment for furnishing any shop drawings, procedures or supporting calculations, but the cost thereof shall be considered as included in the general cost of the work.

7. Coordination Drawings [CD]: When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and submit coordination drawings for review. Drawings shall be searchable.

The Contractor shall prepare coordination drawings according to requirements in other Contract provisions, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

Coordination Drawings shall include Project-specific information drawn accurately to a scale large enough to indicate and resolve conflicts. Coordination Drawings shall not be based on standard printed data. Coordination Drawings shall include the following information, as applicable: (1) use applicable plans as a basis for preparation of Coordination Drawings and prepare sections, elevations, and details as needed to describe relationship of various systems and components; (2) coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review; (3) indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems; (4) indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation; (5)

show location and size of access doors required for access to concealed dampers, valves, and other controls; (6) indicate required installation sequences; (7) indicate dimensions shown on the plans, specifically noting dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements, and (8) provide alternate sketches to the Designer indicating proposed resolution of such conflicts. The Contractor shall ensure the Coordination Drawings are signed by each installer, indicating their approval prior to submission.

There will be no direct payment for furnishing any coordination drawings, but the cost thereof shall be considered as included in the general cost of the work.

8. Product Data [PD]: When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and submit product data for review in a PDF file.

The Contractor shall provide all product data in a single submittal for each element of construction or system and shall mark each submittal with the Contract item number.

The Contractor shall mark each copy of a product data submittal to show applicable choices and options. Where product data includes information on several products that are not required, copies shall be marked to indicate the applicable information. Product data shall include the following information and confirmations to the extent applicable: manufacturer's printed recommendations, compliance with recognized trade association standards, compliance with recognized testing agency standards, application of testing agency labels and seals, notation of coordination requirements, and any other information required by the individual Contract provisions.

There will be no direct payment for furnishing any product data, but the cost thereof shall be considered as included in the general cost of the work.

9. Product Samples [PS]: When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and submit product samples for review.

Product Samples are samples submitted for review and action by the Designer, which are: (1) physically identical to the proposed product or material cured and finished as required by the Contract; or (2) submitted for review of kind, color, pattern, thickness, and texture. Samples shall be used for a final check of these characteristics with other elements, and for a comparison of the characteristics of the approved sample with those of the actual component as delivered and installed.

The following information shall be submitted with product samples to the extent applicable: Contract number; Project description; generic description of the sample (name or trade reference, type or quality or grade, and any further designation necessary to identify the items or materials); sample source; product name; manufacturer's name; confirmation of availability; and anticipated delivery time.

In conjunction with the submission of physical product samples, a digital photograph of the sample shall be uploaded into COMPASS.

The Designer will retain one set of the samples, transmit one set of same to the Engineer. The Engineer will retain the samples at the Project Site for quality comparisons throughout the duration of the Project.

There will be no direct payment for furnishing any product samples, but the cost thereof shall be considered as included in the general cost of the work.

10. Quality Assurance Submittals [QA]: When required by the Contract, or when ordered to do so by the Engineer, the Contractor shall prepare and submit quality assurance submittals for review in a single PDF file.

Quality assurance submittals consist of qualification data, design data, certifications, manufacturer's instructions, manufacturer's field reports, test reports, Material Safety Data Sheets (MSDSs), and other quality assurance information required by individual Contract provisions.

Where Contract provisions require certification that a product, material, or installation complies with specified requirements, the Contractor shall submit a notarized certification from the manufacturer certifying said compliance. An officer of the manufacturer or other individual authorized to sign documents on behalf of the company shall sign the certification.

Where Contract provisions require the Contractor shall provide a certification letter on the manufacturer's letterhead to certify that asbestos is not contained in the materials.

The manufacturer certification letter shall be formatted in the following manner: [Addressed to:] Commissioner of Transportation Department of Transportation P.O. Box 317546 Newington, Connecticut 06131-7546 Project Title and Number [We] hereby certify that all materials manufactured by [Insert Manufacturer Name] are asbestos-free. [Signature:] [Name of authorized signatory] [Title]

Submittals associated with these materials will not be reviewed without the required manufacturer certification letter.

There will be no direct payment for furnishing any quality assurance submittals, but the cost thereof shall be considered as included in the general cost of the work.

11. Submittal Reviewer's Action: The Designer or Engineer will review each submittal, mark each with a uniform, self-explanatory action stamp, and return the stamped submittal promptly to the Contractor. The stamp will be marked as follows to indicate the action taken:

(a) If submittals are marked "No Exceptions Noted," the Designer or Engineer has not observed any statement or feature that appears to deviate from the Contract requirements. This disposition is contingent on being able to execute the manufacturer's written warranty in compliance with the Contract provisions.

(b) If submittals are marked "Exceptions as Noted," the considerations or changes noted by the Designer or Engineer are necessary in order for the submittal to comply with Contract requirements. This disposition is contingent on being able to execute the manufacturer's written warranty in compliance with the Contract provisions.

(c) If submittals are marked "Revise and Resubmit," the Contractor shall revise and resubmit the submittal to address the deficiencies or provide additional information requested by the Designer or Engineer

(d) If submittals are marked "Rejected," the Contractor shall prepare and submit a new submittal in accordance with the Designer's notations.

(e) If submittals are primarily for information or record purposes, the Designer will return the submittal marked "No Action Required." This disposition is contingent on being able to execute the manufacturer's written warranty in compliance with the Contract provisions.

The Contractor shall not proceed with the part of the Project covered by the submittal until the submittal is marked "No Exceptions Noted," "Exceptions as Noted," or "No Action Required" by the Designer or the Engineer. The Contractor shall retain sole responsibility for compliance with all Contract requirements.

The Contractor shall print 1 color copy of each submittal marked "No Exceptions Noted," "Exceptions as Noted," or "No Action Required" to the Assistant District Engineer for use by the Engineer within 7 calendar days of the completed submittal review. The Contractor shall not

perform physical work related to the submittal until the 2 color copies are provided to the Assistant District Engineer.

The Contractor shall mark up one set of Working Drawings (including any related calculations), Shop Drawings, and Coordination Drawings and retain them as a "Record Document."

Maintenance manuals and warranties will not be returned unless they are Rejected."

1.20-1.05.07—Facilities Construction – Coordination with Work by Other Parties:

Add the following after the last paragraph:

[The following paragraph is project specific. The example is based on the Milford Repair Facility.]

"The Contractor is hereby advised of the Engineer's and the Department personnel's intent to use the existing vehicle repair bays, the specialty repair bays, and the weld shop until the Department accepts and occupies the replacement spaces. The Contractor shall cooperate with the Engineer during construction operations to minimize conflicts and facilitate Engineer and Department personnel usage. The Contractor, the Engineer, and the Department personnel will coordinate construction operations and Department operations on a daily basis, if necessary."

1.20-1.05.08— Facilities Construction – Schedules and Reports:

Delete the first sentence and replace with the following:

"Transmittals of Schedules: The schedule package shall be uploaded into COMPASS using the Submittals/Transmittals application. The submittal process is described in of the CT DOT COMPASS Contractor's User Manual.

The Contractor shall use naming conventions described in the CT DOT COMPASS Contractor's User Manual unless otherwise directed by the Designer.

When a project coordinator is not required by the Contract the following shall apply:"

1.20-1.05.23 – Facilities Construction – Requests for Information (RFI's) and Requests for Change (RFC's):

Delete the first paragraph and replace with the following:

"The Contractor shall upload all RFIs and RFCs into COMPASS using the Submittals/Transmittals application. The submittal process is described in the CT DOT COMPASS Contractor's User Manual.

The Contractor shall use naming conventions described in the CT DOT COMPASS Contractor's User Manual unless otherwise directed by the Designer.

The Engineer will forward the RFI or RFC to the Designer for review. Upon receipt of an RFI or RFC, the Designer will attempt to determine if additional information is required from the Contractor to respond to the RFI or RFC and request said information from the Engineer."

1.20-1.06.08 – Facilities Construction – Warranties

Delete paragraph 8 starting "Prior to the date for the Substantial Completion Inspection to the end of the Article.

"Prior to the date of the Substantial Completion Inspection, the Contractor shall compile each required warranty, properly executed by the Contractor or any other required party. The warranties shall be uploaded into COMPASS using the Submittals/Transmittals application. The submittal process is described in the CT DOT COMPASS Contractor's User Manual.

The Contractor shall use naming conventions described in the CT DOT COMPASS Contractor's User Manual unless otherwise directed by the Designer.

The Contractor shall submit warranties in PDF format, assembling the complete warranty submittal package into a single electronic PDF file with bookmarks enabling navigation to each item and providing a bookmarked table of contents at beginning of document. The Contractor shall place the warranty documents in an orderly sequence based on the organization of the Contract provisions (including specific CSI-formatted specifications contained within a particular Special Provision). Multi-page PDF's shall be limited to 250 MB; larger PDF files will need to be broken up and contained in the same submittal. "PDF Packages" shall not be submitted via COMPASS.

The Contractor shall include a description of the product or installation, including the name of the product, and the name, address and telephone number of the Contractor or pertinent subcontractor.

The Contractor shall furnish to the Department a written warranty for all Project work accompanied by a cover letter with the following contents:

> [Addressed to:]
>
> Commissioner of Transportation
> Department of Transportation
> P.O. Box 317546
> Newington, Connecticut 06131-7546
>
> Project Title and Number
>
> [We] hereby warrant all materials and workmanship for all work performed under this Contract for a period of one (1) year from [date of issuance of C.O.C.] against failures of workmanship and materials in accordance with the Contract. Furthermore, as a condition of this warranty, [we] agree to have in place all insurance coverage identified in the Contract for the performance of any warranty work.
>
> [Signature:] [Name of authorized signatory]
> [Title]

Upon determination by the Engineer that Project work covered by a warranty has failed, the Contractor shall replace or rebuild the work to an acceptable condition complying with Contract

requirements. The Contractor is responsible for the cost of replacing or rebuilding defective construction or components and those which may have needed to be damaged or removed in order to cure the defective work including costs of material, equipment, labor, and material disposal, regardless of whether or not the State has benefited from use of the work through a portion of its anticipated useful service life. The Contractor shall respond to the Project Site when Project work covered by a warranty has failed within 3 calendar days, unless in the Engineer's opinion said failure is deemed to be an emergency, in which case the Contractor shall respond to the Project Site as directed by the Engineer.

When Project work covered by a warranty has failed and been corrected by replacement or rebuilding, the Contractor shall reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the time that remains on the original warranty period at the time of the failure."

1.20-1.08.01—Facilities Construction – Transfer of Work or Contract:

[For compliance with FHWA's Form 1273, and the regulations that the Form 1273 implements (23 CFR 635.116(a)), the minimum work performed by the prime is 30%, so include the following if applicable.]

Replace "25%" with "30%" in the first sentence.

[Include 1.20-1.08.02 below on projects that include a construction field office but do not require the Contractor to provide a set of building and fire codes.]

1.20-1.08.02—Facilities Construction – Establishment of Construction Field Office:

Delete the second paragraph.

1.20-1.08.03—Facilities Construction – Prosecution of Work:

[This is project specific. The example is based on the Milford Repair Facility Project. Verify that all Special Provisions are referenced for payment i.e. there should be no new work assigned here. Do not include here if adequately addressed on the plans.]

Add the following as a new section 6:

"**6. Project Phasing:** Although the Contractor is responsible for developing its own phasing plan for the Engineer's approval for the Project work, the following outline phasing plan requires certain Project work to be performed during specific time periods:

<u>Time Period: Start of Construction to October 31, 2014</u>
The Contractor shall:

A. Furnish and install storage containers where shown on plan sheet SD-005. The first storage containers established on the Project Site shall be for Stores due to the anticipated

duration required for the Department to relocate the Stockroom from the existing building. Provide temporary power as shown on electrical plan sheets.

B. Furnish or relocate, and install personnel office trailers where shown on plan sheet SD-005. Provide temporary power and communications as shown on electrical plan sheets.

C. Relocate and install personnel restroom trailers where shown on plan sheet SD-005. Provide temporary water from existing water services and temporary sewer (gravity pipes to an existing manhole and a grinder pump station). Provide temporary power as shown on electrical plan sheets.

Once all temporary facilities described above and shown on the plans are fully operational and accepted by the Engineer, the Department personnel will:

A. Continue to occupy the Repair Bays, Specialty Repair Bays, and the Weld Shop.
B. Vacate the remaining areas of the building.

and the Contractor shall:

A. Begin fuel island construction.
B. Begin building construction/renovation. Maintain utilities until replacement utilities are operational and accepted by the Engineer.

1. Perform asbestos abatement.
2. Begin demolition, salvage, and lead remediation.
3. Construct the Electrical Room to the extent required to start construction of the electrical service entrance, the fuel island electrical, and related electrical equipment.
4. Relocate and install temporary aboveground waste oil tank prior to the removal of the existing underground waste oil tank.

C. Begin site work.
D. Complete fuel island construction, include off-site communications. Once operational and accepted by the Engineer, demolish the existing fuel island.
E. Complete establishment of temporary facilities for Department personnel by installing block heater receptacles where shown on the plans.

<u>Time Period: November 1, 2014 to March 31, 2015</u>
Block heater receptacles shall be operational. The Contractor shall continue building construction/renovation and site work.

<u>Time Period: April 1, 2015 to End of Construction</u>
Block heater receptacles shall be operational starting on November 1, 2015.

The Contractor shall:

A. Complete building renovation/construction of the Offices, Stockroom, and new bay areas.

1. Relocate existing equipment to the new bays prior to the Semi-Final Inspection for these bays. Equipment includes, but is not limited to, the following: the existing drive-on lift, the existing lubricant storage tanks/drums, and the existing weld shop/repair bay equipment. Coordinate with the Engineer and Department personnel to schedule these relocations to minimize their impacts on Department activities.

B. Complete site work except for the front parking lot area closest to Banner Drive.

The Engineer will hold a Semi-Final Inspection for the areas of the Project described above. Once accepted by the Department, Department personnel will occupy these areas.

and the Contractor shall:

A. Remove temporary facilities that are no longer required as described in Form 816 Article 1.20-1.08.03.
B. Remove abandoned temporary facilities for Department personnel.
C. Complete site work within the front parking lot.
D. Complete building renovation/construction of the Maintenance Bays.

The Engineer will hold a Semi-Final Inspection for the remainder of the Project. Once accepted by the Department, Department personnel will occupy the remaining areas.

The Contractor shall:

A. Remove temporary facilities that are no longer required as described in Form 816 Article 1.20-1.08.03.
B. Remove abandoned temporary facilities for Department personnel.
C. Restore the Project Site."

1.20-1.08.04—Facilities Construction – Limitation of Operations:

[This is project specific. Add language to clarify the interaction of the Contractor and other unrelated construction activities on the site. The example is based on the Milford Repair Facility Project. Verify that all Special Provisions are referenced for payment i.e. there should be no new work assigned here.]

Add following the last paragraph.

"The Contractor shall repair at its own expense any and all damage caused by construction operations to existing buildings unless said damage is scheduled as part of the Project work. The Contractor shall take all precautions necessary to protect the building and its occupants during the construction period. Access to the existing building for purposes of demolition work will not be granted until Final Inspection of the temporary facilities has been completed and the temporary facilities are capable of being occupied by the Department without deterring the Department's employees from performing their assigned work.

During all times that the Project Site is occupied by the Engineer and Department personnel, the Contractor shall maintain the following utilities and services to the extent described to permit Department operations:

1. Electrical Service: The Department will be responsible for paying all monthly electrical utility usage costs related to the existing facilities occupied by Department personnel (unless otherwise noted) including the temporary service for the temporary Department facilities. For this reason, temporary electric heat will not be permitted to be used on this Project. Additionally, the Contractor shall be responsible for paying all monthly electrical usage utility costs related to their construction field office.
2. Telephone Service: The Department will be responsible for paying all monthly telephone utility usage costs related to the existing facilities occupied by Department personnel. The Contractor shall be responsible for paying all monthly telephone utility usage costs related to their construction field office.
3. Water Service: The Contractor shall install and maintain water services to the Personnel Restroom Trailers until the restroom trailers are no longer required. The Contractor shall also install and maintain water services to (2) hose bibs in the Vehicle Repair Bays until the new Repair Bays are occupied by the Department. The Department will be responsible for paying all monthly water service utility usage costs.
4. Heat: From each October 1 to April 1 of each following year, the Contractor shall maintain 68 degrees F space temperature throughout all of the Vehicle Repair Bays, Specialty Repair Bays, and the Weld Shop occupied by the Department. The Contractor shall accomplish this by providing either temporary or permanent heat at their discretion except that no electric heat will be permitted unless the monthly electrical usage utility costs are paid for by the Contractor. The Contractor will need to provide temporary heat in the remaining portions of the building as needed to support its construction activities.
5. Bay Area Drainage: Vehicle Repair Bay, Specialty Repair Bay, and the Weld Shop drainage systems shall remain operational at all times when said spaces are occupied by Department personnel. Unless the Contractor's work negatively impact the oil-water separator, the Department is responsible for maintenance of the oil-water separator. While the oil-water separator is not monitored by a tank monitoring system, the Department will check the oil level on a monthly basis and empty it as necessary.
6. Sanitary Drainage: The existing repair facility grinder pump station and alarm light shall remain operational at all times. Additionally, the Contractor shall install and maintain sanitary services from the Personnel Restroom Trailers until the restroom trailers are no longer required. The Department will be responsible for paying all monthly utility usage costs.
7. Fire Alarm System: The Contractor shall keep the fire alarm system control panel and the Vehicle Repair Bays, Specialty Repair Bays, and the Weld Shop heat/smoke detectors, pull stations, and horn/strobe units operational until the new fire alarm system is installed, tested, and accepted by the Engineer.
8. Compressed Air System: The Contractor shall keep the compressed air system in the Vehicle Repair Bays, Specialty Repair Bays, and the Weld Shop operational.

9. Waste Oil Tank (Existing): The Contractor shall keep the existing underground waste oil tank operational until they install the temporary 500 gallon aboveground waste oil tank provided on-site by the Department.
10. Tank Monitoring System (Existing): The Contractor shall keep the existing tank monitoring system operational until they begin to remove the existing underground waste oil tank, the existing underground Paint Bay heating oil tank, and the existing aboveground building heating oil tank.

[The Department will fill the temporary aboveground storage tanks upon their acceptance by the Engineer.]

The Contractor is hereby advised of the need to perform the following Project work related to the Vehicle Repair Bays, Specialty Repair Bays, and the Weld Shop when the building is unoccupied (between the hours of 4 p.m. and 6.a.m. or on weekends, except during winter storms) to minimize the impacts to the Department Personnel, unless otherwise approved by the Engineer:

1. Asbestos abatement.
2. Demolition, salvage of materials, and lead remediation.
3. Odorous work such as interior painting.
4. Complicated overhead work such as welding hydronic or sprinkler piping.
5. Any work that negatively impacts the ability of Department Personnel from performing their assigned duties. This includes but is not limited to utility or building services work/interruptions."

[The following sample relates to existing motor fuel islands. Retain if applicable. Revise for the Project.]

With the exception of one (1) four-week shutdown period for renovation work, the existing motor fuel island shall be operational to permit gasoline and diesel fueling operations at all times throughout construction. The existing motor fuel island shall be accessible by Department personnel at all times.

During this shutdown period, the Contractor shall perform all work related to the existing motor fuel island as noted on the plans. This work shall include, but is not limited to, the following:

A. Relocate the electrical panel, submersible pump controls, disconnect switches, etc. within Stores.
B. Relocate the emergency stop switch, island light, and dispenser power switches to the new Stores Office.
C. Install emergency stop switch on FMU on fuel island.
D. Install telecommunications outlet on outside of building.
E. Salvage existing tank monitoring system from all underground tanks on the Project Site.
F. Install tank monitoring system in the gasoline, diesel fuel, fuel oil, and generator tanks, and the oil-water separators. Install console in Stores Office.

During the shutdown period, the Contractor shall stick the gasoline, diesel fuel, and fuel oil tanks daily and record the results in a log book.

At the end of the shutdown period, the complete motor fuel island and tank monitoring system associated with the gasoline, diesel fuel, and fuel oil tanks shall be fully operational. The tank monitoring system shall be accessible by Department personnel at all times.

1.20-1.08.14 – Facilities Construction – Acceptance of Project

Delete 4. Operation and Maintenance Manuals down to "Product Maintenance Manual" and replace with the following:

"4. Operation and Maintenance Manuals: Prior to the date of the Semi-Final Inspection, the Contractor shall compile operation and maintenance manuals in the form of instructional manuals for use by the Owner. The operation and maintenance manuals shall be uploaded into COMPASS using the Submittals/Transmittals application. The submittal process is described in the CT DOT COMPASS Contractor's User Manual.

The Contractor shall use naming conventions described in the CT DOT COMPASS Contractor's User Manual unless otherwise directed by the Designer.

The Contractor shall submit manuals in the form of a multi-page PDF format for each manual type required using electronic files prepared by the manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable size. The Contractor shall place the warranty documents in an orderly sequence based on the organization of the Contract provisions (including specific CSI-formatted specifications contained within a particular Special Provision). Multi-page PDF's shall be limited to 250 MB; larger PDF files will need to be broken up and contained in the same submittal. "PDF Packages" shall not be submitted via COMPASS.

For each manual, the Contractor shall:

(a) Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

(b) Provide a title page as the first page of each manual with the following information: subject matter covered by the manual; Contract number and title; date of submittal; name, address, and telephone number of the Contractor; and cross-reference to related systems in other sections.

(c) Provide a table of contents, arranged systematically according to the organization of the Contract provisions (including specific CSI-formatted specifications within a particular Special Provision).

(d) Provide a general information section immediately following the table of contents, listing each product included in the manual, identified by product name. The Contractor shall

list the name, address, and telephone number of the subcontractor, the maintenance contractor, and the local source for replacement parts and equipment for each product.

(e) Include manufacturer's standard data and mark each sheet to identify each part or product included in the Project, identify each product using appropriate references from the Contract, and delete references to information that is not applicable. The use of project record documents as part of operation and maintenance manuals is not permitted.

(f) Prepare supplementary text to provide operation and maintenance information when the manufacturer's standard data is not available or the data is insufficient and the information is necessary for proper operation and maintenance of equipment or systems, organize text in a consistent format under separate headings for each procedure, and provide a logical sequence of instruction for each operation or maintenance procedure.

(g) Provide drawings where necessary in order to supplement manufacturer's data to illustrate the relationship of component parts of equipment or systems or to provide control or flow diagrams. The Contractor shall coordinate these drawings with information contained in project record drawings to ensure correct illustration of the completed installation. The use of Project record documents as part of operation and maintenance manuals is not permitted.

(h) Provide estimated life cycle costs to maintain each product included in the manual to reach maximum useful life (i.e. annual, mid-life overhaul, end of life overhaul, or programmed interval replacement)."

Delete the last 2 paragraphs of 5. Training ("The Contractor shall submit ... owner for unlimited reproduction.") and replace with the following:

"The Contractor shall video record each training session."

ON-THE-JOB TRAINING (OJT) WORKFORCE DEVELOPMENT PILOT:

Description

To provide construction industry related job opportunities to minorities, women and economically disadvantaged individuals; and to increase the likelihood of a diverse and inclusive workforce on Connecticut Department of Transportation (ConnDOT) projects.

All contractors (existing and newcomers) will be automatically placed in the Workforce Development Pilot. Standard OJT requirements typically associated with individual projects will no longer be applied at the project level for new projects. Instead, these requirements will be applicable on an annual basis for each contractor performing work on ConnDOT projects.

The OJT Workforce Development Pilot will allow a contractor to train employees on Federal, State and privately funded projects located in Connecticut. However, contractors should give priority to training employees on ConnDOT Federal-Aid funded projects.

Funding

The Department will establish an OJT fund annually from which contractors may bill the Department directly for eligible trainee hours. The funds for payment of trainee hours on federal-aid projects will be allocated from the ½ of 1% provided for OJT funding, and will be based on hours trained, not to exceed a maximum of $25,000.00 per year; per contractor.

Minorities and Women

Developing, training and upgrading of minorities, women and economically disadvantaged individuals toward journeyperson level status is the primary objective of this special training provision. Accordingly, the Contractor shall make every effort to enroll minority, women and economically disadvantaged individuals as trainees to the extent that such persons are available within a reasonable area of recruitment. This training commitment is not intended, and shall not be used, to discriminate against any applicant for training whether a member of a minority group or not.

Assigning Training Goals

The Department, through the OJT Program Coordinator, will assign training goals for a calendar year based on the contractor's past two year's activities and the contractor's anticipated upcoming year's activity with the Department. At the beginning of each year, all contractors eligible will be contacted by the Department to determine the number of trainees that will be assigned for the upcoming calendar year. At that time, the Contractor shall enter into an agreement with the Department to provide a self-imposed on-the-job training program for the calendar year. This agreement will include a specific number of annual training goals agreed to by both parties. The number of training assignments may range from one (1) to six (6) per

contractor per calendar year. Each January, a summary of the trainees required and the OJT Workforce Development Pilot package will be sent to participating contractors. The number of trainees assigned to each contractor in the summary will increase proportionately not to exceed 6, as shown in the following table. This package will also be provided to contractors as they become newly eligible for the OJT Workforce Development Pilot throughout the remainder of the year. Projects awarded after September 30 will be included in the following year's Program.

The dollar thresholds for training assignments are as follows:

$4.5 – 8 million=	1 trainee
$ 9 – 15 million=	2 trainees
$16 – 23 million=	3 trainees
$24 – 30 million=	4 trainees
$31 – 40 million=	5 trainees
$41 – and above=	6 trainees

Training Classifications

Preference shall be given to providing training in the following skilled work classifications. However, the classifications established are not all-inclusive:

Equipment Operators	Electricians
Laborers	Painters
Carpenters	Iron / Reinforcing Steel Workers
Concrete Finishers	Mechanics
Pipe Layers	Welders

The Department has on file common training classifications and their respective training requirements; that may be used by the contractors. Contractors shall submit new classifications for specific job functions that their employees are performing. The Department will review and recommend for acceptance the new classifications proposed by contractors, if applicable. New classifications shall meet the following requirements:

Proposed training classifications are reasonable and realistic based on the job skill classification needs, and the number of training hours specified in the training classification is consistent with common practices and provides enough time for the trainee to obtain journeyman level status.

Where feasible, 25% percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. The number of trainees shall be distributed among the work classifications on the basis of the contractor's needs and the availability of journeymen in the various classifications within a reasonable area of recruitment.

No employee shall be employed as a trainee in any classification in which they have successfully completed a training course leading to journeyman level status or in which they have been employed as a journeyman.

Records and Reports

The Contractor shall maintain enrollment in the program and submit all required reports documenting company compliance under these contract requirements. These documents and any other information shall be submitted to the OJT Program Coordinator as requested.

Upon the trainee's completion and graduation from the program, the Contractor shall provide each trainee with a certification Certificate showing the type and length of training satisfactorily completed.

Trainee Interviews

In order to determine the continued effectiveness of the OJT Program in Connecticut, the department will periodically conduct personal interviews with current trainees and may survey recent graduates of the program. This enables the OJT Program Coordinator to modify and improve the program as necessary. Trainee interviews are generally conducted at the job site to ensure that the trainees' work and training is consistent with the approved training program.

Trainee Wages

Contractors shall compensate trainees on a graduating pay scale based upon a percentage of the prevailing minimum journeyman wages (Davis-Bacon Act). Minimum pay shall be as follows:

60 percent	of the journeyman wage for the first half of the training period
75 percent	of the journeyman wage for the third quarter of the training period
90 percent	of the journeyman wage for the last quarter of the training period

In no case, will the trainee be paid less than the prevailing rate for general laborer as shown in the contract wage decision (must be approved by the Department of Labor).

Achieving or Failing to Meet Training Goals

The Contractor will be credited for each trainee currently enrolled or who becomes enrolled in the approved training program and providing they receive the required training under the specific training program. Trainees will be allowed to be transferred between projects if required by the Contractor's schedule and workload. The OJT Program Coordinator must be notified of transfers within five (5) days of the transfer or reassignments by e-mail (Phylisha.Coles@ct.gov).

Where a contractor does not or cannot achieve its annual training goal with female or minority trainees, they must produce adequate Good Faith Efforts documentation. Good Faith Efforts are those designed to achieve equal opportunity through positive, aggressive, and continuous result-oriented measures. 23 CFR § 230.409(g) (4). Contractors should request minorities and females from unions when minorities and females are under-represented in the contractor's workforce.

Whenever a contractor requests ConnDOT approval of someone other than a minority or female, the contractor must submit documented evidence of its Good Faith Efforts to fill that position with a minority or female. When a non-minority male is accepted, a contractor must continue to attempt to meet its remaining annual training goals with females and minorities.

Where a contractor has neither attained its goal nor submitted adequate Good Faith Efforts documentation, ConnDOT will issue a letter of non-compliance. Within thirty (30) days of receiving the letter of non-compliance, the contractor must submit a written Corrective Action Plan (CAP) outlining the steps that it will take to remedy the non-compliance. The CAP must be approved by ConnDOT. Failure to comply with the CAP may result in your firm being found non-responsive for future projects.

Measurement and Payment

Optional reimbursement will be made to the contractor for providing the required training under this special provision on ConnDOT Federal-Aid funded projects only.

Contractor will be reimbursed at $0.80 for each hour of training given to an employee in accordance with an approved training or apprenticeship program. This reimbursement will be made even though the Contractor receives additional training program funds from other sources, provided such other source does not specifically prohibit the contractor from receiving other reimbursement.

Reimbursement for training is made annually or upon the trainees completion and not on a monthly basis. No payment shall be made to the Contractor if either the failure to provide the required training, or the failure to hire the trainee as a journeyperson, is caused by the Contractor.

Program reimbursements will be made directly to the prime contractor on an annual basis. To request reimbursement, prime contractors must complete the Voucher for OJT Workforce Development Pilot Hourly Reimbursement for each trainee in the OJT Program. This form is included in the OJT Workforce Development Pilot package and is available on the Department's web site at:

www.ct.gov/dot

The completed form must be submitted to the Office of Contract Compliance for approval. The form is due on the 15th day of January for each trainee currently enrolled and for hours worked on ConnDOT Federal-Aid funded projects only.

SMALL CONTRACTOR AND SMALL CONTRACTOR MINORITY BUSINESS ENTERPRISES (SET-ASIDE)

March, 2001

NOTE: Certain of the requirements and procedures stated in this "Special Provision" are applicable prior to the execution of the Contract.

I. GENERAL

A. The Contractor shall cooperate with the Connecticut Department of Transportation (CONNDOT) in implementing the required contract obligations concerning "Small Contractor" and "Small Contractor Minority Business Enterprise" use on this Contract in accordance with Section 4a-60g of the Connecticut General Statutes as revised. References, throughout this "Special Provision", to "Small Contractors" are also implied references to "Small Contractor Minority Business Enterprises" as both relate to Section IIA of these provisions. The Contractor shall also cooperate with CONNDOT in reviewing the Contractor's activities relating to this provision. This "Special Provision" is in addition to all other equal opportunity employment requirements of this Contract.

B. For the purpose of this "Special Provision", the "Small Contractor(s)" and "Minority Business Enterprise(s)" named to satisfy the set-aside requirement must be certified by the Department of Administrative Services, Business Connections/ Set-Aside Unit [(860) 713-5236 www.das.state.ct.us/busopp.htm] as a "Small Contractor" and "Minority Business Enterprises" as defined by Section 4a-60g Subsections (1) and (3) of the Connecticut General Statutes as revised and is subject to approval by CONNDOT to do the work for which it is nominated pursuant to the criteria stipulated in Section IIC-3.

C. Contractors who allow work which they have designated for "Small Contractor" participation in the pre-award submission required under Section IIC to be performed by other than the approved "Small Contractor" organization and prior to concurrence by CONNDOT, will not be paid for the value of the work performed by organizations other than the "Small Contractor" designated.

D. If the Contractor is unable to achieve the specified contract goals for "Small Contractor" participation, the Contractor shall submit written documentation to CONNDOT's Manager of Construction Operations indicating his/her good faith efforts to satisfy goal requirements. Documentation is to include but not be limited to the following:

1. A detailed statement of the efforts made to select additional subcontract opportunities for work to be performed by each "Small Contractor" in order to increase the likelihood of achieving the stated goal.

2. A detailed statement, including documentation of the efforts made to contact and solicit contracts with each "Small Contractor", including the names, addresses, dates and telephone numbers of each "Small Contractor" contacted, and a description of the information provided to each "Small Contractor" regarding the scope of services and anticipated time schedule of items proposed to be subcontracted and the nature of response from firms contacted.

3. For each "Small Contractor" that placed a subcontract quotation which the Contractor considered not to be acceptable, provide a detailed statement of the reasons for this conclusion.

4. Documents to support contacts made with CONNDOT requesting assistance in satisfying the contract specified or adjusted "Small Contractor" dollar requirements.

5. Document other special efforts undertaken by the Contractor to meet the defined goal.

E. Failure of the Contractor to have at least the specified dollar amount of this contract performed by "Small Contractor" as required in Section IIA of this "Special Provision" will result in the reduction in contract payment to the Contractor by an amount equivalent to that determined by subtracting from the specific dollar amount required in Section IIA, the dollar payments for the work actually performed by each "Small Contractor". The deficiency in "Small Contractor" achievement, will therefore, be deducted from the final contract payment. However, in instances where the Contractor can adequately document or substantiate its good faith efforts made to meet the specified or adjusted dollar amount to the satisfaction of CONNDOT, no reduction in payments will be imposed.

F. All records must be retained for a period of three (3) years following completion of the contract and shall be available at reasonable times and places for inspection by authorized representatives of CONNDOT.

G. Nothing contained herein, is intended to relieve any contractor or subcontractor or material supplier or manufacturer from compliance with all applicable Federal and State legislation or provisions concerning equal employment opportunity, affirmative action, nondiscrimination and related subjects during the term of this Contract.

II. **SPECIFIC REQUIREMENTS**

In order to increase the participation of "Small Contractors", CONNDOT requires the following:

A. Not less than **25 (%)** percent of the **final** value of this Contract shall be subcontracted to and performed by, and/or supplied by, manufactured by and paid to "Small Contractors" and/or "Small Contractors Minority Business Enterprises".

If the above percentage is zero (0%) AND an asterisk (*) has been entered in the adjacent brackets [ ], this Contract is 100% solely set-aside for participation by "Small Contractors" and/or "Small Contractors Minority Business Enterprises".

B. The Contractor shall assure that each "Small Contractor" will have an equitable opportunity to compete under this "Special Provision", particularly by arranging solicitations, time for the preparation of Quotes, Scope of Work, and Delivery Schedules so as to facilitate the participation of each "Small Contractor".

C. The Contractor shall provide to CONNDOT's Manager of Contracts within Seven (7) days after the bid opening the following items:

1. An affidavit (Exhibit I) completed by each named "Small Contractor" subcontractor listing a description of the work and indicating the dollar amount of all contract(s) and/or subcontract(s) that have been awarded to him/her for the current State Fiscal Year (July 1 - June 30) does not exceed the Fiscal Year limit of $10,000,000.00.

2. A certification of work to be subcontracted (Exhibit II) signed by both the Contractor and the "Small Contractor" listing the work items and the dollar value of the items that the nominated "Small Contractor" is to perform on the project to achieve the minimum percentage indicated in Section IIA above.

3. A certification of past experience (Exhibit III) indicating the scope of work the nominated "Small Contractor" has performed on all projects, public and private, for the past two (2) years.

4. In instances where a change from the originally approved named "Small Contractor" (see Section IB) is proposed, the Contractor is required to submit, in a reasonable and expeditious manner, a revised submission, comprised of the documentation required in Section IIC, Paragraphs 1, 2 and 3 and Section E together with documentation to substantiate and

justify the change, (i.e., documentation to provide a basis for the change) to CONNDOT's Manager of Construction Operations for its review and approval prior to the implementation of the change. The Contractor must demonstrate that the originally named "Small Contractor" is unable to perform in conformity to specifications, or unwilling to perform, or is in default of its contract, or is overextended on other jobs. The Contractor's ability to negotiate a more advantageous contract with another "Small Contractor" is not a valid basis for change. Documentation shall include a letter of release from the originally named "Small Contractor" indicating the reason(s) for the release.

D. After the Contractor signs the Contract, the Contractor will be required to meet with CONNDOT's Manager of Construction Operations or his/her designee to review the following:

1. What is expected with respect to the "Small Contractor" set aside requirements.

2. Failure to comply with and meet the requirement can and will result in monetary deductions from payment.

3. Each quarter after the start of the "Small Contractor" the Contractor shall submit a report to CONNDOT's Manager of Construction Operations indicating the work done by, and the dollars paid to each "Small Contractor" to date.

4. What is required when a request to sublet to a "Small Contractor" is submitted.

E. The Contractor shall submit to CONNDOT's Manager of Construction Operations all requests for subcontractor approvals on standard forms provided by the Department.

If the request for approval is for a "Small Contractor" subcontractor for the purpose of meeting the contract required "Small Contractor" percentage stipulated in Section IIA, a copy of the legal contract between the Contractor and the "Small Contractor" subcontractor must also be submitted at the same time. Any subsequent amendments or modifications of the contract between the Contractor and the "Small Contractor" subcontractor must also be submitted to CONNDOT's Manager of Construction Operations with an explanation of the change(s). The contract must show items of work to be performed, unit prices and, if a partial item, the work involved by both parties.

In addition, the following documents are to be attached:

(1) A statement explaining any method or arrangement for renting equipment. If rental is from a Contractor, a copy of Rental Agreement must be submitted.

(2) A statement addressing any special arrangements for manpower.

(3) A statement addressing who will purchase material.

F. Contractors subcontracting with a "Small Contractor" to perform work or services as required by this "Special Provision" shall not terminate such firms without advising CONNDOT, in writing, and providing adequate documentation to substantiate the reasons for termination if the designated "Small Contractor" firm has not started or completed the work or the services for which it has been contracted to perform.

G. Material Suppliers or Manufacturers

If the Contractor elects to utilize a "Small Contractor" supplier or manufacturer to satisfy a portion or all of the specified dollar requirements, the Contractor must provide the Department with:

1. An executed Affidavit Small Contractor (Set-Aside) Connecticut Department of Transportation Affidavit Supplier or Manufacturer (sample attached), and

2. Substantiation of payments made to the supplier or manufacturer for materials used on the project.

Brokers and packagers shall not be regarded as material Suppliers or manufacturer.

H. Non-Manufacturing or Non-Supplier "Small Contractor" Credit

Contractors may count towards its "Small Contractor" goals the following expenditures with "Small Contractor" firms that are not manufacturers or suppliers:

1. Reasonable fees or commissions charged for providing a bona fide service such as professional, technical, consultant or managerial services and assistance in the procurement of essential personnel, facilities, equipment, material or supplies necessary for the performance of the contract provided that the fee or commission is determined by the Department of Transportation to be reasonable and consistent with fees customarily allowed for similar services.

2. The fees charged for delivery of materials and supplies required on a job site (but not the cost of the materials and supplies themselves) when the hauler, trucker, or delivery service is not also the manufacturer of or a regular dealer in the materials and supplies, provided that the fee is determined by the Department of Transportation to be reasonable and not excessive as compared with fees customarily allowed for similar services.

3. The fees or commissions charged for providing any bonds or insurance specifically required for the performance of the Contract, provided that the fee or commission is determined by the Department of Transportation to be reasonable and not excessive as compared with fees customarily allowed for similar services.

III. BROKERING

For the purpose of this "Special Provision", a "Broker" is one who acts as an agent for others in negotiating contracts, purchases, sales, etc., in return for a fee or commission. Brokering of work by a "Small Contractor" is not allowed and is a contract violation.

IV. PRE-AWARD WAIVERS:

If the Contractor's submission of the "Small Contractor" listing, as required by Section IIC indicates that it is unable, by subcontracting to obtain commitments which at least equal the amount required by Section IIA, it may request, in writing, a waiver of up to 50% of the amount required by Section IIA. To obtain such a waiver, the Contractor must submit a completed "Application for Waiver of Small Contractor Minority Business Enterprise Goals" to CONNDOT's Manager of Contracts which must also contain the following documentation:

1. Information described in Section ID.

2. For each "Small Contractor" contacted but unavailable, a statement from each "Small Contractor" confirming its unavailability.

Upon receipt of the submission requesting a waiver, the CONNDOT's Manager of Contracts shall submit the documentation to the Director of the Office of Contract Compliance who shall review it for completeness. After completion of the Director of Contract Compliance's review, she/he should write a narrative of his/her findings of the application for a waiver, which is to include his/her recommendation. The Director of Contract Compliance shall submit the written narrative to the Chairperson of the DBE Screening Committee at least five (5) working days before the scheduled meeting. The Contractor shall be invited to attend the meeting and present his/her position. The DBE Screening Committee shall render a decision on the waiver request within five (5)

working days after the meeting. The DBE Screening Committee's decision shall be final. Waiver applications are available from the CONNDOT Manager of Contracts.

EXHIBIT I Mar. 01

SMALL CONTRACTOR/*MINORITY BUSINESS ENTERPRISE
(* Delete if not Applicable)
SET-ASIDE PROGRAM
(QUALIFICATION AFFIDAVIT)

PROJECT(s) _____
(INCLUDING TOWN & DESCRIPTION)

STATE OF _____CONNECTICUT_____

COUNTY OF_____

I_____,ACTING IN BEHALF
NAME OF PARTY SIGNING AFFIDAVIT
OF_____,DO HEREBY CERTIFY
PERSON FIRM OR ORGANIZATION
AND AFFIRM THAT THE INFORMATION SET FORTH BELOW IS TRUE AND ACCURATE TO THE BEST OF MY KNOWLEDGE. AS OF THIS DATE_____THE LIST OF SMALL CONTRACTOR SET-ASIDE PROGRAM - CONTRACTS AND/OR SUBCONTRACTS AWARDED DURING THE CURRENT FISCAL YEAR (JULY 1 - JUNE 30) 20_____ IS AS FOLLOWS:

Col. 1 TOWN AND PROJECT NUMBER	Col. 2 STATE AGENCY WHICH AWARDED CONTRACT	Col. 3 CONTRACT AMOUNT AWARDED UNDER THIS PROGRAM	Col. 4 AMOUNT OF WORK SUBCONTRACTED FROM OTHER FIRMS UNDER THIS PROGRAM	Col. 5 TOTAL AMOUNT OF ALL WORK UNDER THIS PROGRAM Col. 3 Plus Col. 4
	TOTALS	$	$	$

_____
NAME OF PERSON, FIRM OR ORGANIZATION

(FIRM SEAL)

_____
SIGNATURE & TITLE OF OFFICIAL

SWORN TO AND SUBSCRIBED BEFORE ME BY_____

WHO IS PERSONALLY KNOWN TO ME, THIS_____DAY OF_____, 20_____

_____
(NOTARY PUBLIC)

MY COMMISSION EXPIRES_____SEAL

PLEASE NOTE THAT ALL THE WORK AWARDED OR SUBCONTRACTED TO YOUR FIRM UNDER THE SET-ASIDE PROGRAM IN A FISCAL YEAR (JULY 1-JUNE 30) INCLUDING THIS PROJECT, CANNOT BE MORE THAN $10,000,000.00

Mar.01

EXHIBIT II

DEPARTMENT OF TRANSPORTATION
CONTRACT DIVISION
2800 BERLIN TURNPIKE
NEWINGTON, CT 06111

CERTIFICATION OF WORK TO BE SUBCONTRACTED
NOMINATED SMALL CONTRACTOR/*MINORITY BUSINESS ENTERPRISE

* Delete if not applicable

PLEASE INCLUDE A COPY OF CERTIFICATION LETTER

CONTRACTOR_____

ADDRESS_____

TOWN_____PROJECT NO._____

DESCRIPTION OF PROJECT_____

_____

CONTRACT BID AMOUNT $_____

DATE_____

Listed below is the Nominated Small Contractor/Minority Business Enterprise for the above project and the requested data:

Name, Address & Tel No. of the Nominated Firm	ITEM(s)NUMBER(s) and Description of the Item(s) to be performed by and paid to the Subcontractor	Quantities (indicate if partial)	Prime's Bid Amount For Item	Dollar Amount Subcontracted	Small Business Set-Aside Dollar Requirement

Signed By _____
Small Contractor/*Minority Business Enterprise
(Subcontractor)

Signed By_____
Contractor

Title_____

EXHIBIT III

Mar.01

CERTIFICATION
PAST CONSTRUCTION EXPERIENCE

SMALL CONTRACTOR / * MINORITY BUSINESS ENTERPRISES

* Delete if not applicable

PLEASE LIST ALL CONSTRUCTION PROJECTS YOUR ORGANIZATION HAS WORKED ON IN THE PAST TWO FISCAL YEARS

PROJECT LOCATION NUMBER AND DESCRIPTION APPLICABLE	CONTRACT AMOUNT	IF WORK PERFORMED AS PRIME GIVE OWNERS NAME IF WORK PERFORMED AS SUBCONTRACTOR GIVE CONTRACTORS NAME	START DATE	ACTUAL OR ESTIMATED COMPLETION DATE	NAME AND PHONE OF OWNER OR PRIME CONTRACTOR AS

SIGNED BY: _____

SMALL BUSINESS CONTRACTOR
*MINORITY BUSINESS ENTERPRISES

D.O.T. PROJECT NO. _____

* Delete if not applicable

MARCH, 2001

SMALL CONTRACTOR/SMALL CONTRACTOR MINORITY BUSINESS ENTERPRISE (MBE) (SET-ASIDE) CONNECTICUT DEPARTMENT OF TRANSPORTATION AFFIDAVIT – SUPPLIER OR MANUFACTURER

This affidavit must be completed by the State Contractor's designated Small Contractor/ Small Contractor Minority Business Enterprise (MBE), notarized and attached to the contractor's request to utilize a Small Contractor/Small Contractor Minority Business Enterprise (MBE) supplier or manufacturer as a credit towards its Small Contractor/Small Contractor Minority Business Enterprise (MBE) contract requirement; failure to do so will result in not receiving credit towards the contract Small Contractor/Small Contractor Minority Business Enterprise (MBE) requirement.

State Project No. _____
Federal Aid Project No. _____
Description of Project _____

I, _____, acting in behalf of _____
(Name of person signing Affidavit) (Small Contractor/Small Contractor MBE contractor person,
_____ of which I am the_____ affirm that _____
firm, association or certify and corporation) (Title of Person) (Small
_____is a certified Small Contractor/Small
Contractor/Small Contractor MBE person, firm, association or corporation)
Contractor Minority Business Enterprise, as defined by Section 4a-60g of the Connecticut General Statutes, as revised.

I further certify and affirm that _____
(Small Contractor/Small Contractor MBE person, firm, association or corporation)
will assume the actual and contractual responsibility for the provision of the materials and/or supplies sought by _____. If a manufacturer, I produce goods from raw
(State Contractor)
materials or substantially alter them before resale, or if a supplier, I perform a commercially useful function in the supply process.

I understand that false statements made herein are punishable at Law (Sec. 53a-157, CGS, as revised).

_____
(Name of Small Contractor/Small Contractor MBE person, firm, association or corporation)

_____
(Signature and Title of Official making the Affidavit)

Subscribed and sworn to before me, the _____ day of _____ 200____.

_____
Notary Public (Commissioner of the Superior Court)

My Commission Expires _____

CERTIFICATE OF CORPORATION

I, _____, certify that I am the _____ (Official) of the Corporation named in the foregoing instrument; that I have been duly authorized to affix the seal of the Corporation to such papers as require the seal; that _____, who signed said instrument on behalf of the Corporation, was then _____ of said corporation; that said instrument was duly signed for and in behalf of said Corporation by authority of its governing body and is within the scope of its corporation powers.

_____

(Signature of Person Certifying) (Date)

(Corporate Seal)

ITEM #0020801A – ASBESTOS ABATEMENT

Description:

Work under this item shall include the abatement of asbestos containing materials (ACM) and associated work by persons who are knowledgeable, qualified, trained and licensed in the removal, treatment, handling, and disposal of ACM and the subsequent cleaning of the affected environment. ACM shall include material composed of any type of asbestos in amounts greater than one percent (1%) by weight. The Contractor performing this work shall possess a valid Asbestos Abatement Contractor license issued by the Connecticut Department of Public Health (CTDPH).

These Specifications govern all work activities that disturb asbestos containing materials. All activities shall be performed in accordance with, but not limited to, the current revision of the OSHA General Industry Standard for Asbestos (29 CFR 1926.1001), the OSHA Asbestos in Construction Regulations (29 CFR 1926.1101), the USEPA Asbestos National Emission Standards for Hazardous Air Pollutants (NESHAP) Regulations (40 CFR Part 61 Subpart M), the CTDPH Standards for Asbestos Abatement, Licensure and Training (19a-332a-1 through 16, 20-440-1 through 9 & 20-441), and the CTDEEP Special Waste Disposal Regulations (22a-209-8(i)).

The asbestos abatement work shall include the removal and disposal of all ACM as identified on the Contract Plans and Specifications prior to the planned renovation/demolition project.

Deviations from these Specifications require the written approval of the Engineer.

The Contractor may elect to utilize an Alternative Work Practice (AWP), if approved by the CTDPH and the Engineer prior to the initiation of the abatement activities. An AWP is a variance from certain CTDPH asbestos regulatory requirements, which must provide the equivalent or a greater measure of asbestos emission control than the standard work practices prescribed by the CTDPH.

Materials:

All materials shall be delivered to the job site in the original packages, containers, or bundles bearing the name of the manufacturer, the brand name and product technical description.

No damaged or deteriorating materials shall be used. If material becomes contaminated with asbestos, the material shall be decontaminated or disposed of as asbestos-containing waste material. The cost to decontaminate and dispose of this material shall be at the expense of the Contractor.

Fire retardant polyethylene sheet shall be in roll size to minimize the frequency of joints, with factory label indicating four (4) or six (6) mil thickness.

Six (6) mil polyethylene disposable bags shall have pre-printed OSHA/EPA/DOT labels and shall be transparent.

Tape (or equivalent) capable of sealing joints in adjacent polyethylene sheets and for the attachment of polyethylene sheets to finished or unfinished surfaces must be capable of adhering under both dry and wet conditions.

Surfactant is a chemical wetting agent added to water to improve penetration and shall consist of fifty (50) percent polyoxyethylene ether and fifty (50) percent polyoxyethylene ester, or equivalent. The surfactant shall be mixed with water to provide a concentration one (1) ounce surfactant to five (5) gallons of water, or as directed by the manufacturer.

Spray equipment must be capable of mixing necessary chemical agents with water, generating sufficient pressure and volume; and equipped with adequate hose length to access all necessary work areas.

Sanders, grinders, wire brushes and needle-gun type removal equipment shall be equipped with a High Efficiency Particulate Air (HEPA) filtered vacuum dust collection system.

Containers for storage, transportation and disposal of asbestos containing waste material shall be impermeable and both air and watertight.

Labels and warning signs shall conform to OSHA 29 CFR 1926.1101, USEPA 40 CFR Part 61.152, and USDOT 49 CFR Part 172 as appropriate.

Encapsulant, a material used to chemically entrap asbestos fibers to prevent these fibers from becoming airborne, shall be of the type which has been approved by the Engineer. Use shall be in accordance with manufacturer's printed technical data. The encapsulant shall be clear and must be compatible with new materials being installed, if any.

Mastic removal chemicals shall be low odor and non-citrus based, with a flash point in excess of 140° F.

Any planking, bracing, shoring, barricades and/or temporary sheet piling, necessary to appropriately perform work activities shall conform to all applicable federal, state and local regulations.

Air filtration devices and vacuum units shall be equipped with HEPA filters.

Construction Methods:

(1) Pre-Abatement Submittals and Notices

(a) The Contractor shall submit, in accordance with CTDPH Standard 19a-332a-3 and EPA 40 CFR 61.145(b), proper notifications using the prescribed forms, to the Commissioner, State of Connecticut, Department of Public Health and EPA Region 1, not fewer than ten (10) business days prior to the commencement of work as follows:

1. Asbestos abatement projects involving greater than ten (10) linear feet (LF) or twenty-five (25) square feet (SF) of ACM (friable or non-friable) within a facility (i.e. interior abatement) and/or greater than 10 LF or 25 SF of friable ACM outside a facility, require a CTDPH Asbestos Abatement Notification. Also, abatement projects greater than one hundred sixty (160) SF, two hundred sixty (260) LF or 35 cubic feet (CF) of interior/exterior Regulated Asbestos Containing Materials (RACM) require Notification of Demolition & Renovation to EPA Region 1.

2. At sites scheduled for demolition, asbestos abatement of exterior non-friable ACM or interior abatement involving less than 10 LF or 25 SF of ACM (friable or non-friable), and/or exterior abatement involving less than 10 LF or 25 SF of friable ACM require Demolition Notifications to CTDPH. Any site scheduled for demolition also requires notification to the EPA (regardless of ACM or not). In most cases, the Demolition Contractor is responsible for filing the Demolition Notifications not fewer than ten (10) days prior to the commencement of demolition. However, if a portion of the demolition activities are scheduled to be conducted in conjunction with and/or under the supervision of an Asbestos Abatement Contractor (i.e. in the event of a structure which has been condemned, structurally damaged, and/or deemed unsafe for asbestos abatement activities); then it is the responsibility of the Asbestos Abatement Contractor to submit the Demolition Notifications.

3. In the event that a CTDPH Asbestos Abatement Notification and EPA Notification of Demolition & Renovation have been submitted and the subject facility is scheduled for demolition, a separate CT Demolition Notification form does not need to be submitted. In such cases, the submission of the CTDPH Asbestos Abatement Notification form shall be deemed as satisfying the requirement for the CT notification of the demolition of the facility.

4. The Contractor filing the proper notification is responsible for all associated fees.

5. If the Contractor intends to dispose of ACM waste within the State of Connecticut, a copy of the Asbestos Abatement/Demolition Notification must also be submitted to the Department of Environmental Protection, Solid Waste Management Unit, and the Contractor must obtain a CTDEEP Special Waste Disposal authorization.

(b) Fifteen (15) working days prior to the commencement of asbestos abatement work, the Contractor shall submit to the Engineer for review and acceptance and/or acknowledgment of the following:

1. Permits and licenses for the removal, transport, and disposal of asbestos-containing or contaminated materials, including a CTDPH valid asbestos removal contractor's license.

2. Documentation dated within the previous twelve (12) months, certifying that all employees have received USEPA Model Accreditation Plan approved asbestos worker/supervisor training in the proper handling of materials that contain asbestos; understand the health implications and risks involved, including the illnesses possible from exposure to airborne asbestos fibers; understands the use and limits of respiratory equipment to be used; and understands the results of monitoring of airborne quantities of asbestos as related to health and respiratory equipment as indicated in 29 CFR 1926.1101 on an initial and annual basis, and copies of all employees CTDPH asbestos worker and/or supervisor licenses.

3. Documentation from the Contractor, typed on company letterhead and signed by the Contractor, certifying that all employees listed therein have received the following:

    a. medical monitoring within the previous twelve (12) months, as required in 29 CFR 1926.1101;
    b. respirator fit testing within the previous twelve (12) months as detailed in 29 CFR 1910.134 (for all employees who must also don a tight-fitting face piece respirator).

4. Copies of the EPA/State-approved certificates for the proposed asbestos landfill.

(c) No abatement shall commence until a copy of all required submittals have been received and found acceptable to the Engineer. Those employees added to the Contractor's original list will be allowed to perform work only upon submittal to, and receipt of, all required paperwork by the Engineer.

(2) Asbestos Abatement Provisions:

(a) General Requirements

The Abatement Contractor/Subcontractor shall possess a valid State of Connecticut Asbestos Contractor License. Should any portion of the work be subcontracted, the subcontractor must also possess a valid State of Connecticut Asbestos Contractor License. The Asbestos Abatement Site Supervisor employed by the Contractor shall be in control on the job site at all times during asbestos abatement work. All employees of the Contractor who shall perform work (i.e. Asbestos

Abatement Site Supervisor, Asbestos Abatement Worker) shall be properly certified/licensed by the State of Connecticut to perform such duties.

All labor, materials, tools, equipment, services, testing, insurance (with specific coverage for work on asbestos), and incidentals which are necessary or required to perform the work in accordance with applicable governmental regulations, industry standards and codes, and these Specifications shall be provided by the Contractor. The Contractor shall be prepared to work all shifts and weekends throughout the course of this project.

Prior to beginning work, the Engineer and Contractor shall perform a visual survey of each work area and review conditions at the site for safety reasons. In addition, the Contractor shall instruct all workers in all aspects of personnel protection, work procedures, emergency evacuation procedures and use of equipment including procedures unique to this project.

The Contractor shall:

> Shut down and lock out electrical power, including all receptacles and light fixtures, when feasible. The use or isolation of electrical power will be coordinated with all other ongoing uses of electrical power at the site.
>
> When necessary, provide temporary power and adequate lighting and ensure safe installation of electrical equipment, including ground fault protection and power cables, in compliance with applicable electrical codes and OSHA requirements. The Contractor is responsible for proper connection and installation of electrical wiring.

Water service may not be available at the site. Contractor shall supply sufficient water for each shift to operate the decontamination shower units as well as to maintain the work areas adequately wet.

Ladders and/or scaffolds shall be in compliance with OSHA requirements, and of adequate length, strength and sufficient quantity to support the scope of work. Use of ladders/scaffolds shall be in conformance with OSHA 29 CFR 1926 Subpart L and X requirements.

Work performed at heights exceeding six feet (6') shall be performed in accordance with the OSHA Fall Protection Standard 29 CFR 1926 Subpart M including the use of fall arrest systems as applicable.

Data provided regarding asbestos sampling conducted throughout the structure(s) is for informational purposes only. Under no circumstances shall this information be the sole means used by the Contractor for determining the presence and location of all asbestos containing materials. The Contractor shall verify all field conditions affecting performance of the work as described in these Specifications in accordance with OSHA, USEPA, USDOT, DEP standards. Compliance with the applicable requirements is solely the responsibility of the Contractor.

The Engineer will provide a Project Monitor to oversee the activities of the Contractor. No asbestos work shall be performed until the Project Monitor is on-site. Pre-abatement, during abatement and post-abatement air sampling will be conducted as deemed necessary by the Project Monitor. Waste stream testing will be performed, as necessary, by the Project Monitor prior to waste disposal.

(b) Set-Up

The Contractor shall establish contiguous to the Regulated Area, a Worker Decontamination Enclosure System consisting of Equipment Room, Shower Room and Clean Room in series, as detailed below. Access to the Regulated Area shall only be through this enclosure.

Access between rooms in the Worker Decontamination Enclosure System shall be through airlocks. Other effective designs are permissible. The Clean Room, Shower Room and Equipment Room located within the Worker Decontamination Enclosure, shall be contiguously connected with taped airtight edges, thus ensuring the sole source of airflow originates from outside the regulated areas, once the negative pressure differential within the Regulated Area is established.

The Clean Room shall be adequately sized to accommodate workers and shall be equipped with a suitable number of hooks, lockers, shelves, etc., for workers to store personal articles and clothing. Changing areas of the Clean Room shall be suitably screened from areas occupied by the public.

The Shower Room shall be of sufficient capacity to accommodate the number of workers. One shower stall shall be provided for each eight (8) workers. Showers shall be equipped with hot and cold or warm running water through the use of electric hot water heaters supplied by the Contractor. No worker or other person shall leave a Regulated Area without showering. Shower water shall be collected and filtered using best available technology and dumped down an approved sanitary drain. Shower stalls and plumbing shall include sufficient hose length and drain system or an acceptable alternate.

The Contractor shall ensure that no personnel or equipment be permitted to leave the Regulated Area until proper decontamination procedures (including HEPA vacuuming, wet wiping and showering) to remove all asbestos debris have occurred. No asbestos-contaminated materials or persons shall enter the Clean Room.

Post warning signs meeting the specifications of OSHA 29 CFR 1910.1001 and 29 CFR 1926.1101 at each Regulated Area. In addition, signs shall be posted at all approaches to Regulated Areas so that an employee or building occupant may read the sign and take the necessary protective steps before entering the area. Additional signs may require posting following construction of workplace enclosure barriers.

(c) **Alternate set up requirements for exterior non-friable asbestos abatement procedures**

In lieu of the establishment of a negative pressure enclosure (NPE) system as described by CTDPH Sections 19a-332a-5(c), 5(d), 5(e), and 5(h), non-friable ACM will be removed from exterior work areas within an outdoor Regulated Area(s). The regulated work area will be established by the use of appropriately labeled barrier tape and postings in compliance with CTDPH 19a-332a-5(a) as well as OSHA 29 CFR 1926.1101. A remote personnel decontamination unit as specified in Section 19a-332a-6 will be required. This method shall only be utilized provided exposure assessment air sampling data collected during the removal of the exterior non-friable materials indicates that the exposure levels during removal of such materials do not exceed 0.1 asbestos f/cc. Should exposure assessment air sampling data exceed this level, and engineering efforts to reduce the airborne fiber levels not be successful in reducing the levels to less than 0.1 f/cc, removal shall occur within these areas under full containment conditions.

(d) Personnel Protection

The Contractor shall utilize all appropriate engineering controls and safety and protective equipment while performing the work in accordance with OSHA, USEPA, USDOT, CTDEEP and CTDPH regulations.

The Contractor shall provide and require all workers to wear protective clothing in the Regulated Areas where asbestos fiber concentrations may reasonably be expected to exceed the OSHA established Permissible Exposure Limits (PEL) or where asbestos contamination exists. Protective clothing shall include impervious coveralls with elastic wrists and ankles, head covering, gloves and foot coverings.

Respiratory protection shall be provided and shall meet the requirements of OSHA as required in 29 CFR 1910.134, and 29 CFR 1926.1101 as well as the requirements of the CTDPH regulations. A formal respiratory protection program must be implemented in accordance with 29 CFR 1926.1101 and 29 CFR 1910.134. The Contractor shall provide respirators from among those approved as being acceptable for protection by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR Part ll.

All other necessary personnel protective equipment (i.e. hardhat, work boots, safety glasses, hearing protection, etc.) required to perform the asbestos abatement work activities shall conform to all applicable federal, state and local regulations.

All other qualified and authorized persons entering into a Regulated Area (i.e. Project Monitor, Regulatory Agency Representative) shall adhere to the requirements of personnel protection as stated in this section.

(e) Asbestos Abatement Procedures

The Asbestos Abatement Site Supervisor, as the OSHA Competent Person shall be at the site at all times.

The Contractor shall not begin abatement work until authorized by the Project Monitor, following a pre-abatement visual inspection.

All workers and authorized persons shall enter and leave the Regulated Area through the Worker Decontamination Enclosure System, leaving contaminated protective clothing in the Equipment Room for reuse or disposal of as asbestos contaminated waste. No one shall eat, drink, smoke, chew gum or tobacco, or apply cosmetics while in a Regulated Area.

The following details the extent of each phase of operation designated for this project. Phase areas may be combined or divided at the direction of the Engineer. Proceed through the sequencing of the work phases under the direction of the Engineer.

Putnam Maintenance Facility – Cold Storage Building

No asbestos containing materials were identified associated with the Cold Storage Building

Putnam Maintenance Facility – Main Building

Phase 1 – Main Building Roof - includes the removal of:

- **Perimeter flashing cement – main building roof**
- **Mechanical unit flashing cement – main building roof**
- **Chimney flashing cement – main building roof**
- **Grey patching cement – main building roof**
- **Pitch box cement – main building roof**

A regulated area(s) shall be established at the perimeter of the work area(s), and access shall be controlled by the Contractor. A remote personnel decontamination unit shall be utilized. Removal shall be undertaken in accordance with OSHA Class II and USEPA Asbestos NESHAP requirements.

Phase 2 – Main Building Exterior - includes the removal of:

- **Exterior window frame caulk (C1) – all exterior windows**
- **Exterior tan/grey pliable door frame caulk (C2) – outside stores, bay 18, bay 24, bay 14 (exit door)**
- **Bay door column/frame caulk (C4) – garage bay door frames throughout**
- **Interior window glazing (type 1) (WG1) – bays 14-24, kitchen, lavatory, clerk room**
- **Interior window glazing (type 3) (WG3) – bays 1-5, bay 9, bay 10, bay 11, bay 12, stores, roofline above repair office & stores, repair office**
- **Bay door column grey brittle caulk (C3) – bay 13 exterior roll up door**
- **Bay door gasket caulk (C5) – all bay doors**

A regulated area(s) shall be established at the perimeter of the work area(s), and access shall be controlled by the Contractor. A remote personnel decontamination unit shall be utilized. Removal shall be undertaken in accordance with OSHA Class II and USEPA Asbestos NESHAP requirements.

Phase 3 – Main Building Interior Boiler Room - includes the removal of:

- **Heavy braided wire insulation – boiler room main switch & main panel**
- **Non-conductive caulk – boiler room emergency panel #7**

Contractor shall be responsible for removal of all walls, counters, cabinets, sinks, appliances, trim work, carpeting, etc., necessary in order to access the ACM. Asbestos removal shall be performed under full containment conditions with a pressure differential and contiguous decontamination system in accordance with CTDPH 19a-332a-5, 6 and 7, OSHA Class I and USEPA NESHAP requirements. Phase 3 reoccupancy air clearance testing shall utilize PCM analysis in accordance with CTDPH 19a-332a-12.

Phase 4 – Main Building Kitchen & Clerk Room - includes the removal of:

- **9" cream w grey streaks floor tile (FT3) – kitchen (bottom layer) & clerk room**

Contractor shall be responsible for removal of all walls, counters, cabinets, sinks, appliances, trim work, carpeting, etc., necessary in order to access the ACM. Asbestos removal shall be performed under full containment conditions with a pressure differential and contiguous decontamination system in accordance with CTDPH 19a-332a-5, 6 and 7, OSHA Class I and USEPA NESHAP requirements. Phase 4 reoccupancy air clearance testing shall utilize PCM analysis in accordance with CTDPH 19a-332a-12.

Phase 5 – Main Building Tire Bay 11 - includes the removal of:

- **Chimney breeching cement (type 2) – tire bay 11**

Asbestos removal shall be performed as a spot repair involving less than three (3) linear or square feet of asbestos, following the OSHA glovebag techniques or using another means of air-tight barriers, in accordance with OSHA Class III and CTDPH 19a-332a-10 requirements, with a remote decontamination system.

During removal, the Contractor shall spray asbestos materials with amended water using airless spray equipment capable of providing a "mist" application to reduce the release of airborne fibers. Spray equipment shall be capable of mixing wetting agent with water and capable of generating sufficient pressure and volume. Hose length shall be sufficient to reach all of the Regulated Area. Do not "flood" the area with hose type water supply equipment with the potential to create water releases from the regulated area.

The Contractor shall continue to spray the asbestos materials with amended water, as necessary, throughout removal activities to ensure the asbestos materials remain adequately wet. The asbestos materials shall not be allowed to dry out.

In order to minimize airborne asbestos concentrations inside the Regulated Area, the Contractor shall remove the adequately wetted asbestos in manageable sections. In addition, asbestos materials removed from any elevated level shall be carefully lowered to the floor.

The Contractor shall promptly place the adequately wet asbestos material in disposal containers (six (6) mil polyethylene bags/fiber drum/poly-lined dumpsters, etc.) as it is removed. Large components removed intact may be wrapped in two (2) layers of six (6) mil polyethylene sheeting secured with tape. As the disposal containers are filled, the Contractor shall promptly seal the containers, apply caution labels and clean the containers before transportation to the equipment decontamination area. Bags shall be securely sealed to prevent accidental opening and leakage by taping in gooseneck fashion. Small components and asbestos-containing waste with sharp-edged components (e.g. nails, screws, metal lath, tin sheeting) which could tear polyethylene bags and sheeting shall be placed in clean drums and sealed with locking ring tops. All waste containers shall be leak-tight, (typically consisting of two layers of 6 mil poly (or bags)), and shall be properly labeled and placarded with OSHA Danger labels, DOT shipping labels, markings and placards and USEPA NESHAP generators labels. Containers shall be decontaminated by wet cleaning and HEPA vacuuming within the equipment decontamination area prior to exiting the regulated area. Wet clean each container thoroughly before moving to Holding Area.

If at any time during asbestos removal, the Project Monitor should suspect contamination of areas outside the Regulated Area, the Contractor shall immediately stop all abatement work and take steps to decontaminate these areas and eliminate causes of such contamination. Unprotected individuals shall be prohibited from entering contaminated areas until air sampling and/or visual inspections determine decontamination.

After completion of abatement work, all surfaces from which asbestos has been removed shall be wet brushed, using a nylon brush, wet wiped and sponged or cleaned by an equivalent method to remove all visible material (wire brushes are not permitted). During this work the surfaces being cleaned shall be kept wet. Cleaning shall also include the use of HEPA filtered vacuum equipment.

The Contractor shall also remove and containerize all visible accumulations of asbestos-containing and/or asbestos-contaminated debris which may have splattered or collected on the polyethylene engineering controls/barriers.

Once the Regulated Area surfaces have dried, the Project Monitor shall perform a thorough post abatement visual inspection utilizing protocols from the ASTM Standard E1368-90 *Standard Practice for Visual Inspection of Asbestos Abatement Projects*. All surfaces within the Regulated Area, including but not limited to ledges, beams, and hidden locations shall be

inspected for visible residue. Evidence of asbestos contamination identified during this inspection will necessitate further cleaning as heretofore specified. The area shall be re-cleaned at the Contractor's expense, until the standard of cleaning is achieved.

Once the area has received a satisfactory post-abatement visual inspection, any equipment, tools or materials not required for completion of the work, shall be removed by the Contractor from the Regulated Area.

(f) Air Monitoring Requirements

1. The Contractor shall:

    a. Provide air monitoring equipment including sample filter cassettes of the type and quantity required to properly monitor operations and personnel exposure surveillance throughout the duration of the project.

    b. Conduct personnel exposure assessment air sampling, as necessary, to assure that workers are using appropriate respiratory protection in accordance with OSHA Standard 1926.1101. Documentation of air sampling results must be recorded at the work site within twenty-four (24) hours and shall be available for review until the job is complete.

2. The Project Monitor, acting as the representative of the Engineer during abatement activities, will:

    a. Collect air samples in accordance with the current revision of the NIOSH 7400 Method of Air Sampling for Airborne Asbestos Fibers while overseeing the activities of the Abatement Contractor. Frequency and duration of the air sampling during abatement will be representative of the actual conditions at the abatement site. The size and configuration of the asbestos project will be a factor in the number of samples required to monitor the abatement activities and shall be determined by the Project Monitor. The following schedule of samples may be collected by the Project Monitor:

        1. Pre-Abatement (Optional)
            a. Background areas
            b. Area(s) adjacent to Work Area(s)
            c. Work Area(s)

        2. During Abatement (Optional)
            a. At the exhaust of air filtering device
            b. Within Regulated Area(s)
            c. Area(s) adjacent to Regulated Areas(s) (exterior to critical barriers)

d. At the Decontamination Enclosure System

Abatement Activity	Pre-Abatement	During Abatement	Post-Abatement
Exterior Non-Friable	---	PCM	---

If air samples collected outside of the Regulated Area during abatement activities indicate airborne fiber concentrations greater than original background levels, or greater than 0.1 f/cc, as determined by Phase Contrast Microscopy, whichever is larger, an examination of the Regulated Area perimeter shall be conducted and the integrity of barriers shall be restored. Cleanup of surfaces outside the Regulated Area using HEPA vacuum equipment or wet cleaning techniques shall be done prior to resuming abatement activities.

(g) Post Abatement Work Area Deregulation

The Contractor shall remove all remaining polyethylene, including critical barriers, and Decontamination Enclosure Systems. HEPA vacuum and/or wet wipe any visible residue which is uncovered during this process. All waste generated during this disassembly process shall be discarded as ACM waste.

A final visual inspection of the work area shall be conducted by the Competent Person and the Project Monitor to ensure that all visible accumulations of suspect materials have been removed and that no equipment or materials associated with the abatement project remain.

The Contractor shall restore all work areas and auxiliary areas utilized during work to conditions equal to or better than original. Any damage caused during the performance of the work activity shall be repaired by the Contractor at no additional expense to the Engineer.

(h) Waste Disposal

Unless otherwise specified, all removed materials and debris resulting from execution of this project shall become the responsibility of the Contractor and removed from the premises. Materials not scheduled for reuse shall be removed from the site and disposed of in accordance with all applicable Federal, State and Local requirements.

Waste removal dumpsters and cargo areas of transport vehicles shall be lined with a layer of six (6) mil polyethylene sheeting to prevent contamination from leaking or spilled containers. Floor sheeting shall be installed first, and shall be extended up sidewalls 12-inches. Wall sheeting shall overlap floor sheeting 24-inches and shall be taped into place.

OSHA “Danger” signs must be attached to vehicles used to transport asbestos-containing waste prior to loading ACM waste. The signs must be posted so that they are plainly visible.

Waste haulers and disposal facilities utilized shall match those indicated on the submitted CTDPH notification.

Ensure all waste containers (bags, drums, etc.) are properly packed, sealed and labeled with USEPA NESHAP generator labels, OSHA danger labels and DOT shipping labels. For each shipment of ACM waste, the Contractor shall complete an EPA-approved asbestos waste shipment record.

Authorized representatives signing waste shipment records on behalf of the generator must have USDOT Shipper Certification training in accordance with HMR 49 CFR Parts 171-180.

Transport vehicles hauling ACM waste shall have appropriate USDOT placards visible on all four (4) sides of the vehicle.

The Contractor shall dispose of asbestos-containing and/or asbestos contaminated material at an EPA authorized site and must be in compliance with the requirements of the Special Waste Provisions of the Office of Solid Waste Management, Department of Environmental Protection, State of Connecticut, or other designated agency having jurisdiction over solid waste disposal.

Any asbestos-containing and/or asbestos-contaminated waste materials which also contain other hazardous contaminants shall be disposed of in accordance with the EPA's Resource Conservation and Recovery Act (RCRA), CTDEEP and ConnDOT requirements. Materials may be required to be stored on-site and tested by the Project Monitor to determine proper waste disposal requirements.

(i) Project Closeout Data:

1. Provide the Engineer, within 30 days of completion of asbestos abatement, a compliance package; which shall include, but not be limited to, the following:

    a. Asbestos Abatement Site Supervisor job log;
    b. OSHA personnel air sampling data;
    c. Completed waste shipment records.

The Contractor shall submit the original completed waste shipment records to the Engineer.

Method of Measurement:

No measurement will be made for the work in this Section. The completed work shall be paid as a lump sum.

Basis of Payment:

The lump sum bid price for this item shall include the specialty services of the Asbestos Removal Contractor including: labor, materials, equipment, insurance, permits, notifications, submittals, personal air sampling, personal protection equipment, temporary enclosures, utility costs, incidentals, fees and labor incidental to the removal, transport and disposal of ACM, including close out documentation.

Final payment for asbestos abatement will not be made until all the project closeout data submittals have been completed (including waste shipment record(s) signed by an authorized disposal facility representative) and provided to the Engineer. Once the completed package has been received in its entirety, the Engineer will make the final payment to the Contractor.

Pay Item	Pay Unit
Asbestos Abatement	Lump Sum

ITEM #0020902A – LEAD COMPLIANCE FOR BUILDING DEMOLITION & RENOVATION

Description:

The work shall be conducted at the Putnam Maintenance Facility, Putnam, Connecticut.

Work under this item shall include activities impacting various materials containing or covered by lead paint and associated work by persons who are knowledgeable, qualified, and trained in the removal, treatment and handling of lead contaminated materials, including the transportation and disposal of non-hazardous lead construction and demolition bulky waste containing or contaminated with lead, the recycling of metallic components covered with lead paint, and the subsequent cleaning of the affected environment. Lead paint includes paint found to contain **any** detectable amount of lead by Atomic Absorption Spectrophotometry (AAS) or X-Ray Fluorescence (XRF).

All activities shall be performed in accordance with, but not limited to, the current revision of the OSHA Lead in Construction Regulations (29 CFR 1926.62), the USEPA RCRA Hazardous Waste Regulations (40 CFR Parts 260 through 274), and the CTDEEP Hazardous Waste Regulations (22a-209-1 and 22a-449(c).

The lead paint activity shall include the demolition/renovation, removal and/or disposal of building components coated with lead painted surfaces as identified on the Contract Plans and Specifications.

Deviations from these Specifications require the written approval of the Engineer.

Materials:

All materials shall be delivered to the job site in the original packages, containers, or bundles bearing the name of the manufacturer, the brand name and product technical description.

No damaged or deteriorating materials shall be used. If material becomes contaminated with lead, the material shall be decontaminated or disposed of as lead-containing waste material. The cost to decontaminate and dispose of this material shall be at the expense of the Contractor.

Fire retardant polyethylene sheet shall be in roll size to minimize the frequency of joints, with factory label indicating four (4) or six (6) mil thickness.

Six (6) mil polyethylene disposable bags shall have pre-printed OSHA/EPA/DOT labels and shall be transparent.

Tape (or equivalent) capable of sealing joints in adjacent polyethylene sheets and for the attachment of polyethylene sheets to finished or unfinished surfaces must be capable of adhering under both dry and wet conditions.

The cleaning agent detergent shall be lead specific, such as TriSodium Phosphate (TSP).

Any chemical stripper and chemical neutralizer to be utilized shall be compatible with the substrate as well as with each other.

Labels and warning signs shall conform to OSHA 29 CFR 1926.62, USEPA 40 CFR 260 through 274 and USDOT 49 CFR 172 as appropriate.

Any planking, bracing, shoring, barricades and/or temporary sheet piling, necessary to appropriately perform work activities shall conform to all applicable federal, state and local regulations.

Air filtration devices and vacuum units shall be equipped with HEPA filters.

Construction Methods:

(1) Pre-Abatement Submittals and Notices

A. Fifteen (15) working days prior to beginning work that impacts lead paint, the Contractor shall submit the following to the Engineer:

1. Copies of all employee certificates, dated within the previous twelve (12) months, relating to OSHA lead awareness and hazard communication training and training in the use of lead-safe work practices.

2. Documentation from the Contractor, typed on company letterhead and signed by the Contractor, certifying that all employees listed therein have received the following:

    a. medical monitoring within the previous twelve (12) months, as required in 29 CFR 1926.62;
    b. biological monitoring within the previous six (6) months, as required in 29 CFR 1926.62;
    c. respirator fit testing within the previous twelve (12) months, as required in 29 CFR 1910.134 (for those who don a tight-fitting face piece respirator).

3. Copies of state-approved certificates for the proposed non-hazardous construction and demolition (C&D) lead debris disposal facility and any concrete/wood or scrap metal recycling facilities.

No activity shall commence until a copy of all required submittals have been received and found acceptable to the Engineer. Those employees added to the Contractor's original list will be allowed to perform work only upon submittal of all required paperwork to, and review by, the Engineer.

Contractor shall provide the Engineer with a minimum of 48 hours notice in advance of scheduling, changing or canceling work activities.

(2) Lead Abatement Provisions

(a) General Requirements:

All employees of the Contractor who perform work impacting lead paint shall be properly trained to perform such duties.

All labor, materials, tools, equipment, services, testing, insurance (with specific coverage for work on lead), and incidentals which are necessary or required to perform the work in accordance with applicable governmental regulations, industry standards and codes, and these Specifications shall be provided by the Contractor. The Contractor shall be prepared to work all shifts and weekends throughout the course of this project.

Prior to beginning work, the Engineer and Contractor shall perform a visual survey of each work area and review conditions at the site for safety reasons. In addition, the Contractor shall instruct all workers in all aspects of personnel protection, work procedures, emergency evacuation procedures and use of equipment including procedures unique to this project.

The Contractor shall:

Shutdown and isolate heating, cooling, and ventilating air systems to prevent contamination and particulate dispersal to the other areas of the building.

Shut down and lock out electrical power, including all receptacles and light fixtures, when feasible. The use or isolation of electrical power will be coordinated with all other ongoing uses of electrical power at the site.

Coordinate all power and fire alarm isolation with the appropriate representatives.

When necessary, provide temporary power and adequate lighting and ensure safe installation of electrical equipment, including ground fault protection and power cables, in compliance with applicable electrical codes and OSHA requirements. The Contractor is responsible for proper connection and installation of electrical wiring.

Ladders and/or scaffolds to be utilized throughout this project shall be in compliance with OSHA requirements, and of adequate length, strength and sufficient quantity to support the scope of

work. Use of ladders/scaffolds shall be in conformance with OSHA 29 CFR 1926 Subpart L and X requirements.

Work performed at heights exceeding six feet (6') shall be performed in accordance with the OSHA Fall Protection Standard 29 CFR 1926 Subpart M including the use of fall arrest systems as applicable.

Electrical service may not be available at the site. Costs for supplying electrical service shall be the responsibility of the Contractor.

Water service may not be available at the site. The Contractor shall supply sufficient water for each shift to operate the wash facility/decontamination shower units in addition to the water needed at the work area.

Data for random lead testing conducted on surfaces throughout the buildings as well as hazardous waste characterization results are available from the Engineer for informational purposes only. Under no circumstances shall this information be the sole means used by the Contractor for determining the extent of lead painted materials. The Contractor shall be responsible for verification of all field conditions affecting performance of the work as described in these Specifications in accordance with OSHA, USEPA, USDOT and CTDEEP standards. Compliance with the applicable requirements is solely the responsibility of the Contractor.

Activity impacting lead painted surfaces shall be performed in a manner which minimizes the spread of lead dust contamination and generation of airborne lead.

The Engineer will provide a Project Monitor to oversee the activities of the Contractor. No activity impacting lead paint shall be performed until the Project Monitor is on-site. Environmental sampling, including ambient air sampling, TCLP waste stream sampling and/or dust wipe sampling, shall be conducted throughout the project as deemed necessary.

(b) Set-Up

The Contractor shall prepare a Regulated Area as follows:

In all areas where airborne exposures may exceed the OSHA PEL, post warning signs meeting the requirements of OSHA 29 CFR 1926.62 at each regulated area.

In addition, signs shall be posted at all approaches to regulated areas so that an employee may read the sign and take the necessary protective steps before entering the area. These signs shall read:

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

Establish a Regulated Area, through the use of appropriate barrier tape, etc. and control unauthorized access into the area throughout the lead paint related activity.

Implement appropriate engineering controls such as critical barriers, poly drop cloths, negative pressure, local exhaust ventilation, wet dust suppression methods, etc. to prevent the spread of lead contamination from the Regulated Area.

For exterior work areas, the Contractor shall use a High Efficiency Particulate Air (HEPA) filtered vacuum dust collection system to remove any visible existing paint chips from the ground to a distance of 20' out from the base of the exterior surface scheduled for lead paint activity prior to commencement of work and extend a 6 mil polyethylene sheet drop cloth on the ground adjacent to the exterior surface scheduled for lead paint activity to contain debris/contamination.

The Contractor shall provide handwash facilities in compliance with 29 CFR 1926.51(f) and 29 CFR 1926.62 regardless of airborne lead exposure. This wash facility will consist, at least, of potable water, towels, soap, and a HEPA vacuum.

If air monitoring data by the Contractor or Project Monitor shows that employee exposure to airborne lead exceeds the OSHA PEL (50 $\mu g/m^3$), shower rooms must be utilized. The Shower Room shall be of sufficient capacity to accommodate the number of workers. One shower stall shall be provided for each eight (8) workers. Showers shall be equipped with hot and cold or warm running water through the use of electric hot water heaters supplied by the Contractor. Shower water shall be collected and filtered using best available technology and dumped down an approved sanitary drain. Shower stalls and plumbing shall include sufficient hose length and drain system or an acceptable alternate.

(c) Personal Protection:

The Contractor shall initially determine if any employee performing construction tasks impacting lead paint may be exposed to lead at or above the OSHA Action Level of 30 micrograms per cubic meter (30 $\mu g/m^3$). Assessments shall be based on initial air monitoring results as well as other relevant information. The Contractor may rely on historical air monitoring data obtained within the past 12 months under workplace conditions closely resembling the process, type of material, control methods, work practices and environmental conditions used and prevailing in the Contractors current operations to satisfy the exposure assessment requirements. Monitoring shall continue as specified in the OSHA standard until a negative exposure assessment is developed.

Until a negative exposure assessment is developed for the required tasks impacting lead paint, the Contractor shall ensure that all workers and authorized person entering the Regulated Area wear protective clothing and respirators in accordance with OSHA 29 CFR 1926.62. Protective clothing shall include impervious coveralls with elastic wrists and ankles, head covering, gloves and foot coverings. Sufficient quantities shall be provided to last throughout the duration of the

project.

Protective clothing provided by the Contractor and used during chemical removal operations shall be impervious to caustic materials. Gloves provided by the Contractor and used during chemical removal shall be of neoprene composition with glove extenders.

Respiratory protective equipment shall be provided and selection shall conform to 30 CFR Part 11, 29 CFR Part 1910.134, and 29 CFR Part 1926.62. A formal respiratory protection program must be implemented in accordance with 29 CFR Part 1926.62 and Part 1910.134.

(d) Lead Abatement Procedures

Ensure that the Competent Person is on the job at all times.

Do not begin abatement work until authorized by the Engineer, following a pre-abatement visual inspection by the Project Monitor.

The Contractor shall ensure proper entry and exit procedures for workers and authorized persons who enter and leave the Regulated Area. All workers and authorized persons shall leave the Regulated Area and proceed directly to the wash or shower facilities where they will HEPA vacuum gross debris from work suit, remove and dispose of work suit, wash and dry face and hands, and vacuum clothes. Do not remove lead chips or dust by blowing or shaking of clothing. Wash water shall be collected, filtered, and disposed of in accordance with federal, state and local water discharge standards.

No one shall eat, drink, smoke, chew gum or tobacco, or apply cosmetics while in the Regulated Area.

The following details the extent of each phase of operation designated for this project. Phase areas may be combined or divided at the direction of the Engineer. Proceed through the sequencing of the work phases under the direction of the Engineer.

<u>Putnam Maintenance Facility – Cold Storage Building</u>

- **No detectable levels of lead paint were identified at the Cold Storage Building**

<u>Putnam Maintenance Facility – Main Building</u>

Phase 1 – Non-metallic Components To Be Impacted

- **Lead paint has been identified on non-metallic components throughout the facility including concrete masonry unit (CMU) block walls, wood wall panels, wood shelves, wood cabinets, concrete columns, wood workbenches, wood door components, and concrete floors/floor striping. All renovation/demolition work impacting those materials shall be conducted within an established lead control**

(regulated) area with a remote handwash facility/decontamination system in accordance with OSHA Lead in Construction Standards. Engineering controls and work practices shall be utilized to prevent the spread of lead dust and debris beyond the work area and limit the generation of airborne lead. Lead painted debris generated from the renovation/demolition of those materials, shall be containerized and stored on-site with the remainder of the non-metallic building waste materials. The Engineer has characterized the projected non-metallic waste stream as non-hazardous construction and demolition (C&D) solid waste. Building structures waste stream characterized as non-hazardous shall be disposed of as non-hazardous construction and demolition (C&D) solid waste at an approved CTDEEP Solid Waste landfill.

- **The painted concrete/CMU block materials CANNOT be recycled/managed as "clean fill" without being analyzed for lead following the Synthetic Precipitation Leaching Procedure (SPLP) and Total Metal Procedures for comparison to the CTDEEP Remediation Standard Regulations (RSRs). Without such determination, those materials shall be managed as non-hazardous C&D solid waste.**

<u>Phase 2 – Metal Components To Be Impacted</u>

- **Lead paint has been identified on various metal interior/exterior components throughout the facility including door components, window components, radiators, equipment and I-beams. All renovation/demolition work impacting those materials shall be conducted within an established lead control (regulated) area with a remote handwash facility/decontamination system in accordance with OSHA Lead in Construction Standards. Engineering controls and work practices shall be utilized to prevent the spread of lead dust and debris beyond the work area and limit the generation of airborne lead. All steel and metal generated from the renovation/demolition of the structure shall be segregated and recycled as scrap metal at an approved facility. The recycling of scrap metal (regardless of lead paint concentration) is exempt from USEPA RCRA and CTDEEP Hazardous Waste Regulation.**

The Contractor shall conduct exposure assessments for the tasks required which impact lead paint in accordance with OSHA 29 CFR 1926.62(d) and shall implement appropriate personal protective equipment until negative exposure assessments are developed.

Utilize appropriate engineering controls (e.g. wet methods) as directed by 29 CFR 1926.62 to control lead emissions and contamination.

Properly contain wastes containing lead paint for appropriate transport/disposal.

Stop all work in the regulated area and take steps to decontaminate non-work areas and eliminate causes of such contamination should lead contamination be discovered in areas outside of the regulated area.

Special Requirements:

1. Demolition:

    a. Demolish in a manner which minimizes the spread of lead contamination and generation of lead dust.

    b. Implement dust suppression controls, such as misters, local exhausts ventilation, etc. to minimize the generation of airborne lead dust.

    c. Segregate work areas from non-work areas through the use or barrier tape, poly criticals, etc.

    d. Clean up immediately after renovation/demolition has been completed

(e) Prohibited Removal Methods:

The use of heat guns in excess of 700 degrees Fahrenheit to remove lead paint is prohibited.

The use of sand, steel grit, water, air, CO_2, baking soda, or any other blasting media to remove lead or lead paint without the use of a HEPA ventilated contained negative pressure enclosure is prohibited.

Power tool assisted grinding, sanding, cutting, or wire brushing of lead paint without the use of cowled HEPA vacuum dust collection systems is prohibited.

Lead paint burning, busting of rivets painted with lead paint, welding of materials painted with lead paint, and torch cutting of materials painted with lead paint is prohibited. Where cutting, welding, busting, or torch cutting of materials is required, pre-remove the lead paint in the area affected.

Use of chemical strippers containing Methylene Chloride is prohibited.

Compressed air shall not be utilized to remove lead paint.

(f) Air Monitoring Requirements

1. The Contractor shall:

    a. Provide air monitoring equipment including sample filter cassettes of the type and quantity required to properly monitor operations and personnel exposure surveillance throughout the duration of the project.

b. Conduct initial exposure monitoring to determine if any employee performing construction tasks impacting lead paint may be exposed to lead at or above the OSHA Action Level of 30 micrograms per cubic meter. Monitoring shall continue as specified in the OSHA standard until a negative exposure assessment is developed.

c. Conduct personnel exposure assessment air sampling, as necessary, to assure that workers are using appropriate respiratory protection in accordance with OSHA Standard 1926.62. Documentation of air sampling results must be recorded at the work site within twenty-four (24) hours and shall be available for review until the job is complete.

2. The Project Monitor will:

a. Collect air samples in accordance with the current revision of the NIOSH 7082 or 7702 Method of Air Sampling for Airborne Lead while overseeing the activities of the Contractor. Frequency and duration of the air sampling during abatement will be representative of the actual conditions at the site. The size and configuration of the project will be a factor in the number of samples required to monitor the activities and shall be determined by the Project Monitor.

As determined by AAS, XRF, or equivalent analysis, if air samples collected outside of the Regulated Area during abatement activities indicate airborne lead concentrations greater than original background levels or greater than 30 ug/m^3, whichever is larger, an examination of the Regulated Area perimeter shall be conducted and the integrity of barriers shall be restored. Cleanup of surfaces outside the Regulated Area using HEPA vacuum equipment or wet cleaning techniques shall be done prior to resuming abatement activities.

Abatement outside the initial designated work area(s) will not be paid for by the Engineer. The Contractor will be responsible for all costs incurred from these abatement activities.

(g) Clean-up and Visual Inspection:

Remove and containerize all lead waste material and visible accumulations of debris, paint chips and associated items.

During clean up the Contractor shall utilize rags and sponges wetted with lead-specific detergent and water as well as HEPA filtered vacuum equipment.

The Engineer will conduct a visual inspection of the work areas in order to document that all surfaces have been maintained as free as practicable of accumulations of lead in accordance with OSHA 29 CFR 1926.62(h). If visible accumulations of waste, debris, lead paint chips or dust are found in the work area, the Contractor shall repeat the cleaning, at the Contractor's expense, until

the area is in compliance. The visual inspection will detect incomplete work, damage caused by the abatement activity, and inadequate clean up of the work site.

(h) Post-Abatement Work Area Deregulation:

Following the visual inspection, (and clearance testing if appropriate,) any engineering controls implemented may be removed and the Work Area deregulated.

A final visual inspection of the work area shall be conducted by the Competent Person and the Project Monitor to ensure that all visible accumulations of suspect materials have been removed and that no equipment or materials associated with the abatement project remain.

The Contractor shall restore all work areas and auxiliary areas utilized during work to conditions equal to or better than original. Any damage caused during the performance of the work activity shall be repaired by the Contractor at no additional expense to the Engineer.

(I) Waste Disposal/Recycling:

Non-metallic building debris waste materials tested and found to be non-hazardous Construction and Demolition (C&D) bulky waste shall be disposed of properly at a CTDEEP approved Solid Waste landfill.

Metallic debris shall be segregated and recycled as scrap metal at an approved metal recycling facility. The Contractor shall submit to the Engineer all documentation necessary to demonstrate the selected recycling facility is able to accept lead-painted scrap metal.

Concrete, brick, etc. coated with <u>any amount of lead paint</u> cannot be crushed, recycled or buried on-site to minimize waste disposal unless tested and found to meet the CT RSR standards as "clean fill". Only CTDEEP defined "clean fill" can be recycled on-site or sent to a recycling facility.

Hazardous lead debris shall be disposed of in accordance with Item 0202317A "Disposal of Hazardous Material".

(j) Project Closeout Data:

1. Provide the Engineer, within thirty (30) days of completion of the project site work, a compliance package; which shall include, but not be limited to, the following:

    a. Competent persons (supervisor) job log;
    b. OSHA-compliant personnel air sampling data;
    c. <u>Completed</u> waste shipment papers for non-hazardous lead construction and demolition (C&D) bulky waste and/or concrete/wood/scrap metal recycling.

Method of Measurement:

No measurement will be made for the work in this Section. The completed work shall be paid as a lump sum.

Basis of Payment:

The lump sum price bid for this item shall include: services, materials, equipment, insurance, all permits, notifications, submittals, personal air sampling, personal protection equipment, temporary enclosures, incidentals, fees and labor incidental to activities impacting lead removal, treatment and handling of lead contaminated materials, and the transport and disposal of any non-hazardous lead construction and demolition (C&D) bulky waste.

Final payment for lead abatement will not be made until all project closeout data submittals have been completed and provided to the Engineer. Once the completed package has been received in its entirety and accepted by the Engineer, final payment will be made to the Contractor.

Pay Item	Pay Unit
Lead Compliance for Building Demolition & Renovation	Lump Sum

END OF SECTION

ITEM #0100069A – REMOVAL OF TANKS

Description:

Work under this shall include all activities related to the removal and disposal of a 275-gallon diesel above-ground storage tank (AST) utilized for the facility's emergency generator. In addition, all of the associated AST equipment and piping shall also be removed as shown on the Contract Plans.

The work shall be performed by an experienced firm that has successfully completed tank removal and disposal work similar to that indicated herein.

All activities shall be performed in accordance with USEPA 40 CFR Parts 260-268, 280 and 281, OSHA 29 CFR 1926, OSHA 29 CFR 1910.120, CTDEEP 22a-449(d)-1 and 22a-449(c), NFPA 30, NFPA 327, API 1604, API 2015, and all other applicable state and federal regulations and codes.

Materials:

All existing structures associated with the generator are to be removed/demolished per the Contract documents. The generator housed within the structure shall be salvaged for the Department's use.

Construction Methods:

(1) Pre-Removal Submittals:

At least fifteen (15) working days prior to the start of any tank removal and disposal work, the Contractor shall submit the following to the Engineer for review and approval:

1. Proposed removal procedures to be utilized, including vapor purging and atmosphere testing.
2. Proposed protective/safety measures to be implemented.
3. Proposed C&D bulky waste disposal facility.
4. Proposed steel/scrap metal recycling facility.

(2) General Provisions:

The Contractor shall clean (remove sludges and residuals), remove, and dispose of one 275-gallon diesel AST located at 3 Industrial Park Road in Putnam, Connecticut, as indicated on the Plans.

Removal and disposal shall include the removal of all appurtenances associated with the tank (e.g., fuel piping, vent piping, conduits, tank and piping monitoring devices, etc.). Removal shall also include all necessary vapor purging, cleaning, etc.

Disposal of petroleum products and other fluids from within the tank and piping structures shall be performed by the Contractor in accordance with *Item No. 0101143A – Handling and Disposal of Regulated Items.*

The Contractor shall exercise all necessary precautions for fire prevention. Acceptable fire extinguishers shall be made available at all times. Flame/torch cutting is prohibited.

The Contractor shall prevent damage to any existing utilities, structures, equipment and appurtenances that are to remain in service.

(3) Vapor Purging:

After removing any combustible contents (i.e., diesel fuel, fuel oil), the atmosphere of the tank shall be tested as indicated in the following section. If the tank atmosphere testing indicates greater than 20% lower explosive limit (LEL), the tank atmosphere shall be purged following the stated method below.

Vapor remaining in the AST shall be displaced by adding solid carbon dioxide (dry ice) to the tank in the amount of at least 0.25 ounces per gallon of tank capacity. The dry ice shall be crushed and distributed evenly over the greatest possible area in the tank to promote rapid evaporation. With the exception of the tank vent, the Contractor shall plug as many tank openings as possible after introducing the dry ice and ensure that vapors are vented to the outside. As the dry ice evaporates, combustible vapors will flow out of the tank and may surround the area. Therefore, the Contractor shall conduct air monitoring around the tank as indicated below. The Contractor shall verify that the dry ice has rendered the internal atmosphere of the tank inert before proceeding with its removal. Alternate vapor purging methods will not be permitted without prior approval from the Engineer.

(4) Atmosphere Testing:

The atmosphere inside and surrounding the AST shall be regularly tested by the Contractor for flammable or combustible vapor concentrations until the tank has been emptied and cleaned in preparation for disposal/recycling. Such tests are to be made with a combustible gas indicator which is properly calibrated and maintained according to the manufacturer's instructions. Contractor personnel responsible for testing must be thoroughly familiar with the use of the instrument and the interpretation of the instrument's readings.

The atmosphere inside the AST shall be tested by placing the combustible gas indicator probe through one of the tank's removable bung openings. Readings shall be taken at the bottom, middle and upper portions of the tank, and the instrument shall be cleared after each reading. Liquid product must not enter the probe. All readings must be 20% or less of the LEL before the tank is considered safe for removal. The Contractor shall also use an oxygen indicator to monitor the oxygen concentration in the tank.

(5) Removal Provisions:

Removal practices shall be acceptable to the Engineer, shall ensure the safety of persons, equipment and structures that are to remain, and shall provide adequate protection of the environment. The Contractor shall schedule removal activities to minimize delays and construction activities on-site.

The Contractor shall furnish and employ any such equipment as may be necessary for the protection of property, proper completion of the work, and the safety of the public and employees of the Contractor and the Department.

Following removal of the tank, the Contractor shall clean all residual product from any impacted surface associated with the AST. Waste products generated from the cleanup efforts of any residual product, shall be managed in accordance to *Item No. 0101143A - Handling and Disposal of Regulated Items*.

(6) Disposal Procedures:

Scrap metal (e.g., tanks, piping, etc.) generated during the removal process shall be recycled as scrap at an approved scrap metal recycling facility following cleaning. Non-hazardous, non-metallic waste shall be recycled off-site or disposed of as C&D bulky waste in accordance with the Connecticut Department of Energy and Environmental Protection (CTDEEP) solid waste management standards. The Contractor shall recycle as much C&D bulky waste as practical.

Removed items shall not be reused or salvaged by the Contractor.

(7) Post-Removal Submittals:

The Contractor shall provide to the Engineer, within 30 days of completion of the tank removal work, a compliance package, which shall include, at a minimum:

1. Shipping papers from the approved solid waste bulky waste disposal/recycling facility indicating receipt and acceptance of C&D bulky waste debris.
2. Shipping papers and Certificates of Destruction/Recycling from the approved scrap metal recycling facility indicating receipt and acceptance of scrap metal debris.

Method of Measurement:

This will be paid for at the contract lump sum price for “Removal of Tanks” complete.

Basis of Payment:

The Contract lump sum price shall include all related necessary work and materials associated with the removal and disposal of the AST, including but not limited to, permits, equipment, material recycling and disposal, air monitoring, and lighting. No additional payment will be made for other material or equipment necessary for the satisfactory completion of the work.

Removal and disposal of residual liquid product from the AST will be in accordance with *Item No. 0101143A – Handling and Disposal of Regulated Items*.

Pay Item	Pay Unit
Removal of Tanks	Lump Sum

ITEM #0100072A – REMOVAL AND DISPOSAL OF UNDERGROUND TANKS

Description:

Work under this Item shall include all activities related to the excavation, removal and disposal of the underground storage tanks (USTs) and their associated equipment and piping, as shown on the Contract Plans at the Putnam Repair and Maintenance Facility. Specifically, the project includes the removal and disposal of a 4,000-gallon fuel oil UST, and a 1,000-gallon oil/water separator (OWS).

Work under this Item shall include all activities related to the excavation, removal and disposal of the USTs and their associated equipment and piping, as shown on the Contract Plans.

The work shall be performed by an experienced firm that has successfully completed UST excavation, removal and disposal work similar to that indicated herein.

All activities shall be performed in accordance with USEPA 40 CFR Parts 260-268, 280 and 281, OSHA 29 CFR 1926, OSHA 29 CFR 1910.120, CTDEEP 22a-449(d)-1 and 22a-449(c), NFPA 30, NFPA 327, API 1604, API 2015, and all other applicable state and federal regulations and codes.

Materials:

Backfill material shall conform to the requirements of Section 2.13 of the Specifications.

Construction Methods:

(1) Pre-Excavation and Removal Submittals:

(a) At least fifteen (15) working days prior to the start of any excavation, removal and disposal work, the Contractor shall submit the following to the Engineer for review and approval:

1. Proposed excavation and removal procedures to be utilized, including UST vapor purging and atmosphere testing.
2. Proposed protective/safety measures to be implemented.
3. Proposed C&D bulky waste disposal facility.
4. Proposed steel/scrap metal recycling facility.

(b) The Contractor shall notify the Department's UST Class A/B Operator, David Hartley, ConnDOT Office of Properties and Facilities, via email (David.Hartley@ct.gov) **45 days prior to the projected date** of the UST removal(s).

(c) Seventy-two (72) hours prior to the start of any excavation/removal activity, the Contractor shall notify the following:

1. Office of the State Fire Marshal, Fire and Life Safety Specialist.
2. Town of Putnam.

Prior to the start of on-site activity, the Contractor shall provide the Engineer with written confirmation that the above contacts have been appropriately notified.

(2) General Provisions:

The Contractor shall clean (remove sludges and residuals), remove and dispose of: one 4,000-gallon fuel oil UST, and one 1,000-gallon OWS at the Putnam Repair and Maintenance Facility located at 3 Industrial Park Road, Putnam, Connecticut.
.
Removal and disposal shall include the removal of all appurtenances associated with the tanks (e.g., manways, fuel piping, vent piping, conduits, tank and piping monitoring devices, etc.). Removal shall also include all necessary vapor purging, defuming, cleaning, etc.

In addition, the removal of the OWS shall include cleaning/pressure-washing of the service bay floor drains and sediment traps associated with the tank to remove all residual sediment and grease prior to its removal.

Disposal of petroleum products, wastewater and sediments from within the tanks, piping structures, floor drains and sediment traps shall be performed by the Contractor in accordance with *Item No. 0101143A – Handling and Disposal of Regulated Items*.

In the event impacted groundwater (as evidenced by visible petroleum sheen or product) is encountered following the removal of the UST(s) from the ground, the Contractor shall be prepared to dewater the excavation as directed by the Engineer to achieve compliance with the Connecticut Department of Energy and Environmental Protection (CTDEEP) UST Regulations. Wastewater generated as a result of these dewatering efforts shall be managed and disposed of in accordance with *Item No. 0101143A - Handling and Disposal of Regulated Items*.

The Contractor shall exercise all necessary precautions for fire prevention. Acceptable fire extinguishers shall be made available at all times. Flame/torch cutting is prohibited.

The Contractor shall prevent damage to any existing utilities, structures, equipment and appurtenances that are to remain in-service.

(3) Vapor Purging:

After removing any combustible contents (i.e., diesel fuel, fuel oil), the atmosphere of the tank shall be tested as indicated in the following section. If the tank atmosphere testing indicates greater than 20% lower explosive limit (LEL), the tank atmosphere shall be purged following the stated method below.

Vapor remaining in the AST shall be displaced by adding solid carbon dioxide (dry ice) to the tank in the amount of at least 0.25 ounces per gallon of tank capacity. The dry ice shall be crushed and distributed evenly over the greatest possible area in the tank to promote rapid evaporation. With

the exception of the tank vent, the Contractor shall plug as many tank openings as possible after introducing the dry ice and ensure that vapors are vented to the outside. As the dry ice evaporates, combustible vapors will flow out of the tank and may surround the area. Therefore, the Contractor shall conduct air monitoring around the tank as indicated below. The Contractor shall verify that the dry ice has rendered the internal atmosphere of the tank inert before proceeding with its removal. Alternate vapor purging methods will not be permitted without prior approval from the Engineer.

(4) Atmosphere Testing:

The atmosphere inside the UST and around the excavation area shall be regularly tested by the Contractor for flammable or combustible vapor concentrations until the tank has been emptied and cleaned in preparation for disposal/recycling. Such tests are to be made with a combustible gas indicator which is properly calibrated and maintained according to the manufacturer's instructions. Contractor personnel responsible for testing must be completely familiar with the use of the instrument and the interpretation of the instrument's readings.

The atmosphere inside the UST shall be tested by placing the combustible gas indicator probe into the fill opening after the drop tube has been removed. If the tank is equipped with a non-removable fill tube, readings shall be taken through another suitable opening. Readings shall be taken at the bottom, middle and upper portions of the tank, and the instrument shall be cleared after each reading. Liquid product must not enter the probe. All readings must be 20 percent or less of the lower explosive limit (LEL) before the tank is considered safe for removal from the ground. The Contractor shall also use an oxygen indicator to monitor the oxygen concentration in the tank.

(5) Excavation and Removal Provisions:

Excavation and removal practices shall be acceptable to the Engineer, shall ensure the safety of persons, equipment and structures that are to remain, and shall provide adequate protection of the environment. The Contractor shall schedule excavation and removal activities to minimize delays and construction traffic on-site.

The Contractor shall furnish and employ such shoring, bracing, pumps, etc., as may be necessary for the protection of property, proper completion of the work, and the safety of the public and employees of the Contractor and the Department.

Excavation by machinery shall be discontinued when excavation approaches pipes, conduits or other underground structures. The work shall be completed in these areas by use of hand tools.

The Contractor shall excavate test pits when necessary to determine the exact location of tank(s), pipe(s) or other underground structure.

For structures not scheduled for demolition, any holes resulting from the removal of vent pipe brackets, return and supply pipes, or other conduits removed or abandoned as a part of excavation and removal activities shall be plugged with cement masonry.

The Contractor shall saw-cut pavement in a neat and workman-like manner anywhere partial pavement removal is necessary to complete the work.

The Contractor shall prevent surface waters from entering the tank excavation area(s) at all times.

The Contractor shall assist in tank grave confirmation sampling by providing equipment and an operator to collect excavation bottom and side-wall soil. After collection of samples, the Contractor shall allow the excavations to remain open pending the receipt of laboratory analytical results by the Engineer. The Contractor shall backfill the excavations immediately upon notification in writing by the Engineer. Any additional excavation beyond that necessary for UST removal shall be as directed by the Engineer. Any tank grave that cannot be backfilled before the end of the work day shall be adequately protected by the Contractor. This includes the use of safety fencing or other appropriate barricades to prevent individuals or vehicles from falling into excavations, orange flashing hazard lighting along the fencing, or other lighting considered necessary by the Engineer.

Excavation areas (tank grave areas, piping removal areas, soil removal areas, etc.) shall be backfilled to grade with surplus suitable excavated "clean fill" materials from the project. Any additional fill material required to bring the subsurface area to grade shall conform to Article 2.13 of the Standard Specifications. Prior to placement of fill materials, areas to be filled shall be free of standing water, frost, frozen material, trash and debris.

After fill placement and compaction, the Contractor shall grade the ground surface to meet adjacent contours and provide flow to surface drainage structures. Grading shall not create any depressions that can retain water, create any diversions to surface flow, or block the intended flow of surface water.

(6) Disposal Procedures:

Scrap metal (e.g., tanks, piping, etc.) generated during the demolition process shall be recycled as scrap at an approved scrap metal recycling facility following cleaning.

Non-hazardous, non-metallic waste shall be recycled off-site or disposed of at a landfill. The Contractor shall transport materials, including but not limited to concrete and asphalt, removed from excavated USTs, and dispose/recycle off-site as C&D bulky waste in accordance with the CTDEEP solid waste management standards. The Contractor shall recycle as much C&D bulky waste as practicable.

Excavated underground items shall not be reused or salvaged by the Contractor.

(7) Post-Excavation and Removal Submittals:

The Contractor shall provide the Engineer, within 30 days of completion of the excavation and removal work, a compliance package, which shall include, but not be limited to, the following:

1. Shipping papers from the approved solid waste bulky waste disposal/recycling facility indicating receipt and acceptance of C&D bulky waste debris.

2. Shipping papers and Certificates of Destruction/Recycling from the approved scrap metal recycling facility indicating receipt and acceptance of scrap metal debris (tank, piping, etc).

Method of Measurement:

This Item will be paid for at the contract lump sum price for "Removal and Disposal of Underground Tanks" complete.

Basis of Payment:

The Contract lump sum price shall include all related necessary work and material associated with the excavation, removal and disposal of the USTs, including but not limited to: permits, equipment, material recycling and disposal, air monitoring, backfill, fencing, barricades, and lighting. No additional payment will be made for shoring, bracing, pumping (i.e., dewatering) or for material or equipment necessary for the satisfactory completion of the work.

Dewatering, if required to facilitate the removal of a UST, will be in accordance with the CTDEEP's *General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities,* unless otherwise specified.

Removal and disposal of residual liquid product from the USTs and/or wastewaters generated from dewatering efforts to achieve compliance with the CTDEEP's UST Regulations be in accordance with *Item No. 0101143A – Handling and Disposal of Regulated Items*.

Pay Item	Pay Unit
Removal and Disposal of Underground Tanks	Lump Sum

ITEM #0100150A – MAINTENANCE FACILITY

Description: Under this item, the Contractor shall complete all work depicted on the Contract Plans and described in the CSI-formatted Specifications that make up this Major Lump Sum Item (MLSI). Refer to Form 818 Article 1.20-1.02.04 for additional information in this regard.

Any work incidental to another bid item which is not specifically described or included in the bid item, but which is required for performance and completion of the work required under the Contract, shall be considered to be included under this item.

Materials: All materials shall be as required by the Contract Plans and as described in the CSI-formatted Specifications that make up this MLSI.

Construction Methods: All methods of construction shall conform to the requirements as stipulated in the CSI-formatted Specifications that make up this MLSI.

Method of Measurement: This item will be paid for at the contract lump sum price for "Maintenance Facility" complete.

Basis of Payment: This item will be paid for at the contract lump sum price for "Maintenance Facility," which price shall include all administrative and procedural requirements, material, equipment, labor, and work incidental thereto.

PAY ITEM	PAY UNIT
Maintenance Facility	LS

ITEM #0101000A - ENVIRONMENTAL HEALTH AND SAFETY

Description:

Under this Item, the Contractor shall establish protocols and provide procedures to protect the health and safety of its employees and subcontractors as related to the proposed construction activities performed within the Project Limits. Work under this Item consists of the development and implementation of a written Health and Safety Plan (HASP) that addresses the relative risk of exposure to potential hazards present within Project Limits. The HASP shall establish health and safety protocols that address the relative risk of exposure to regulated substances in accordance with 29 CFR 1910.120 and 29 CFR 1926.65. Such protocols shall only address those concerns directly related to site conditions.

Note: The Engineer will prepare a site-specific HASP, which is compatible with the Contractor's HASP, and will be responsible for the health and safety of all Project Inspectors, Department employees and consulting engineers.

Materials

The Contractor must provide chemical protective clothing (CPC) and personal protective equipment (PPE) as stipulated in the Contractor's HASP during the performance of work in areas identified as potentially posing a risk to worker health and safety, for workers employed by the Contractor and all subcontractors.

Construction Methods

A. Existing Information

The Contractor shall utilize all available information and existing records and data pertaining to chemical and physical hazards associated with any of the regulated substances identified in the environmental site investigations to develop the HASP. A list of documents containing this data is found in "Notice to Contractor – Environmental Investigations."

B. General

The requirements set forth herein pertain to the provision of workers' health and safety as it relates to proposed Project activities when performed in the presence of hazardous or regulated materials or otherwise environmentally sensitive conditions. THE PROVISION OF WORKER HEALTH AND SAFETY PROTOCOLS, WHICH ADDRESS POTENTIAL AND/OR ACTUAL RISK OF EXPOSURE TO SITE SPECIFIC HAZARDS POSED TO CONTRACTOR EMPLOYEES, IS SOLELY THE RESPONSIBILITY OF THE CONTRACTOR.

The Contractor shall be responsible for the development, implementation and oversight of the HASP throughout the performance of work within the Project Limits. **No intrusive work**

(e.g., excavation) within the Project Limits shall begin until the HASP is reviewed by the Engineer and is determined to meet the requirements of the specifications. However, the Contract time, in accordance with Article 1.03.08, will begin on the date stipulated in the Notice to Proceed.

C. Regulatory Requirements

All construction related activities performed by the Contractor within the Project Limits shall be performed in conformance with 29 CFR 1926, Safety and Health Regulations for Construction and 29 CFR 1910, Safety and Health Regulations for General Industry. Conformance to 29 CFR 1910.120, Hazardous Waste Site Operations and Emergency Response (HAZWOPER) may also be required, where appropriate.

D. Submittals

An electronic copy of the HASP shall be submitted to the Engineer within four (4) weeks after the Award of Contract or four (4) weeks prior to the start of any intrusive work within the Project Limits, whichever is first, but not before the Award of the Contract.

The HASP shall be developed by a qualified person designated by the Contractor. This qualified person shall be a Certified Industrial Hygienist (CIH), Certified Hazardous Material Manager (CHMM), or a Certified Safety Professional (CSP). He/she shall have review and approval authority over the HASP and be identified as the Health and Safety Manager (HSM). The HASP shall bear the signature of said HSM indicating that the HASP meets the minimum requirements of 29 CFR 1910.120 and 29 CFR 1926.65.

The Engineer will review the HASP within four (4) weeks of submittal and provide written comments as to deficiencies in and/or exceptions to the plan, if any, to assure consistency with the specifications, applicable standards, policies and practices and appropriateness given potential or known site conditions. Items identified in the HASP which do not conform to the specifications will be brought to the attention of the Contractor, and the Contractor shall revise the HASP to correct the deficiencies and resubmit it to the Engineer for determination of compliance with this Item. The Contractor shall not be allowed to commence intrusive work activities until the HASP has been reviewed and determined to conform to the requirements of this specification by the Engineer. **No claim for delay in the progress of work will be considered for the Contractor's failure to submit a HASP that conforms to the requirements of the Contract.**

E. HASP Provisions

1. General Requirements

The Contractor shall prepare a HASP covering all Project site work regulated by 29 CFR 1910.120(b)/1926.65(b) to be performed by the Contractor and all subcontractors under this Contract. The HASP shall establish in detail, the protocols necessary for the recognition, evaluation, and control of all hazards associated with each task performed

under this Contract. The HASP shall address site-specific safety and health hazards of each phase of site operation and include the requirements and procedures for employee protection. The level of detail provided in the HASP shall be tailored to the type of work, complexity of operations to be performed, and hazards anticipated. Details about some activities may not be available when the initial HASP is prepared and submitted. Therefore, the HASP shall address, in as much detail as possible, all anticipated tasks, their related hazards and anticipated control measures.

The HASP shall interface with the Contractor's Safety and Health Program. Any portions of the Safety and Health Program that are referenced in the HASP shall be included as appendices to the HASP. All topics regulated by the 29 CFR 1910.120(b) (4) and those listed below shall be addressed in the HASP. **WHERE THE USE OF A SPECIFIC TOPIC IS NOT APPLICABLE TO THE PROJECT, THE HASP SHALL INCLUDE A STATEMENT TO JUSTIFY ITS OMISSION OR REDUCED LEVEL OF DETAIL AND ESTABLISH THAT ADEQUATE CONSIDERATION WAS GIVEN TO THAT TOPIC.**

2. Elements

a. Site Description and Contamination Characterization

The Contractor shall provide a site description and contaminant characterization in the HASP that meets the requirements of 29 CFR 1910.120/1926.65.

b. Safety and Health Risk Analysis/Activity Hazard Analysis

The HASP shall address the safety and health hazards on this site for every operation to be performed. The Contractor shall review existing records and data to identify potential chemical and physical hazards associated with the site and shall evaluate their impact on field operations. Sources, concentrations (if known), potential exposure pathways, and other factors as noted in CFR 1910.120/126.65, paragraph (c)(7) employed to assess risk shall be described. The Contractor shall develop and justify action levels for implementation of engineering controls and personal protective equipment upgrades and downgrades for controlling worker exposure to the identified hazards. If there is no permissible exposure limit (PEL) or published exposure level for an identified hazard, available information from other published studies may be used as guidance. Any modification of an established PEL must be fully documented.

The HASP shall include a comprehensive section that discusses the tasks and objectives of the site operations and logistics and resources required to complete each task. The hazards associated with each task shall be identified. Hazard prevention techniques, procedures and/or equipment shall be identified to mitigate each of the hazards identified.

c. Staff Organization, Qualifications and Responsibilities

The HASP shall include a list of personnel expected to be engaged in site activities and certify that said personnel have completed the educational requirements stipulated in 29 CFR 1910.120 and 29 CFR 1926.65, are currently monitored under a medical surveillance program in compliance with those regulations, and that they are fit for work under "Level C" conditions, if required.

The Contractor shall assign responsibilities for safety activities and procedures. An outline or flow chart of the safety chain of command shall be provided in the HASP. Qualifications, including education, experience, certifications, and training in safety and health for all personnel engaged in safety and health functions shall be documented in the HASP. Specific duties of each on-site team member should be identified.

The HASP shall also include the name and qualifications of the individual proposed to serve as Health and Safety Officer (HSO). The HSO shall have full authority to carry out and ensure compliance with the HASP. The Contractor shall provide a competent HSO on-site who is capable of identifying existing and potential hazards in the surroundings or working conditions which are unsanitary, hazardous or dangerous to employees and who has authorization to take prompt corrective measures to eliminate or control them. The qualifications of the HSO shall include completion of OSHA 40-hour HAZWOPER training, including current 8-hour refresher training, and 8-hour HAZWOPER supervisory training; a minimum of one year of working experience with the regulated compounds that have been documented to exist within Project Limits; a working knowledge of federal and state safety regulations; specialized training or documented experience (one year minimum) in personal and respiratory protective equipment program implementation; the proper use of air monitoring instruments, air sampling methods and procedures; and certification training in first aid and CPR by a recognized, approved organization such as the American Red Cross.

The primary duties of the HSO shall be those associated with worker health and safety. The Contractor's HSO responsibilities shall be detailed in the written HASP and shall include, but not be limited to, the following:

i. Directing and implementing the HASP;

ii. Ensuring that all Project personnel have been adequately trained in the recognition and avoidance of unsafe conditions and the regulations applicable to the work environment to control or eliminate any hazards or other exposure to illness or injury (29 CFR 1926.21). All personnel shall be adequately trained in procedures outlined in the Contractor's written HASP;

iii. Authorizing Stop Work Orders, which shall be executed upon the determination of an imminent health and safety concern;

iv. Contacting the Contractor's HSM and the Engineer immediately upon the issuance of a Stop Work order when the HSO has made the determination of an imminent health and safety concern;

v. Authorizing work to resume, upon approval from the Contractor's HSM;

vi. Directing activities, as defined in the Contractor's written HASP, during emergency situations; and

vii. Providing personal monitoring where applicable, and as identified in the HASP.

d. Employee Training Assignments

The Contractor shall develop a training program to inform employees, supplier's representatives, and official visitors of the special hazards and procedures (including PPE, its uses and inspections) to control these hazards during field operations. Official visitors include, but are not limited to, Federal Agency Representatives, State Agency Representatives, Municipal Agency Representatives, Contractors, subcontractors, etc. This program shall be consistent with the requirements of 29 CFR 1910.120 and 29 CFR 1926.65.

e. Personal Protective Equipment

The HASP shall include the requirements and procedures for employee protection and should include a detailed section on respiratory protection. The Contractor shall describe in detail and provide appropriate PPE to ensure that workers are not exposed to levels greater than the action level for identified hazards for each operation stated for each work zone. The level of protection shall be specific for each operation and shall be in compliance with all requirements of 29 CFR 1910 and 29 CFR 1926. The Contractor shall provide, maintain, and properly dispose of all PPE.

f. Medical Surveillance Program

All on-site Contractor personnel engaged in 29 CFR 1910.120/1926.65 operations shall have medical examinations meeting the requirements of 29 CFR 1910.120(f) prior to commencement of work.

The HASP shall include certification of medical evaluation and clearance by the physician for each employee engaged in 29 CFR 1910.120/1926.65 operations at the site.

g. Exposure Monitoring/Air Sampling Program

The Contractor shall submit an Air Monitoring Plan as part of the HASP, which is consistent with 29 CFR 1910.120, paragraphs (b)(4)(ii)(E), (c)(6), and (h). The Contractor shall identify specific air sampling equipment, locations, and frequencies in the air-monitoring plan. Air and exposure monitoring requirements shall be specified in the Contractor's HASP. The Contractor's designated certified safety professional

(e.g., CIH, CHMM, CSP) shall specify exposure monitoring/air sampling requirements after a careful review of the contaminants of concern and planned site activities.

h. Site Layout and Control

The HASP shall include a map showing work zone delineation (support, contamination, reduction and exclusion), on/off-site communications, site access controls, and security (physical).

i. Communications

Written procedures for routine and emergency communications procedures shall be included in the Contractor's HASP.

j. Personal Hygiene, Personal Decontamination and Equipment Decontamination

Decontamination facilities and procedures for PPE, sampling equipment, and heavy equipment shall be discussed in detail in the HASP.

k. Emergency Equipment and First Aid Requirements

The Contractor shall provide appropriate emergency first aid kits and equipment suitable to treat exposure to the hazards identified, including chemical agents. The Contractor will provide personnel that have certified first aid/CPR training on-site at all times during site operations.

l. Emergency Response Plan and Spill Containment Program

The Contractor shall establish procedures in order to take emergency action in the event of immediate hazards (i.e., a chemical agent leak or spill, fire or personal injury). Personnel and facilities supplying support in emergency procedures will be identified. The emergency equipment to be present on-site and the Emergency Response Plan procedures, as required 29 CFR 1910.120, paragraph (1)(1)(ii) shall be specified in the Emergency Response Plan. The Emergency Response Plan shall be included as part of the HASP. This Emergency Response Plan shall include written directions to the closest hospital as well as a map showing the route to the hospital from the Project location.

m. Logs, Reports and Record Keeping

The Contractor shall maintain safety inspections, logs, and reports, accident/incident reports, medical certifications, training logs, monitoring results, etc. All exposure and medical monitoring records are to be maintained according to 29 CFR 1910 and 29 CFR 1926. The format of these logs and reports shall be developed by the Contractor to include training logs, daily logs, weekly reports, safety meetings, medical

surveillance records, and a phase-out report. These logs, records, and reports shall be maintained by the Contractor and be made available to the Engineer.

The Contractor shall immediately notify the Engineer of any accident/ incident. Within two working days of any reportable accident, the Contractor shall complete and submit an accident report to the Engineer.

n. Confined Space Entry Procedures

Confined space entry procedures, both permit required and non permit required, shall be discussed in detail.

o. Pre-Entry Briefings

The HASP shall provide for pre-entry briefings to be held prior to initiating any site activity and at such other times as necessary to ensure that employees are apprised of the HASP and that this plan is being followed.

p. Inspections/Audits

The HSM or HSO shall conduct inspections or audits to determine the effectiveness of the HASP. The Contractor shall correct any deficiencies in the effectiveness of the HASP.

F. HASP Implementation

The Contractor shall implement and maintain the HASP throughout the performance of work. In areas identified as having a potential risk to worker health and safety, and in any other areas deemed appropriate by the HSO, the Contractor shall be prepared to immediately implement the appropriate health and safety measures, including but not limited to the use of PPE, and engineering and administrative controls.

If the Engineer observes deficiencies in the Contractor's operations with respect to the HASP, they shall be assembled in a written field directive and given to the Contractor. The Contractor shall immediately correct the deficiencies and respond, in writing, as to how each was corrected. Failure to bring the work area(s) and implementation procedures into compliance will result in a Stop Work Order and a written directive to discuss an appropriate resolution(s) to the matter. When the Contractor demonstrates compliance, the Engineer shall remove the Stop Work Order. If a Stop Work Order has been issued for cause, no delay claims on the part of the Contractor will be honored.

Disposable CPC/PPE (i.e. disposable coveralls, gloves, etc.) that come in direct contact with hazardous or potentially hazardous material shall be placed into 55 gallon USDOT 17-H drums and disposed of in accordance with federal, state, and local regulations. The drums shall be temporarily staged and secured within a secure area of the Project, to be approved by the Engineer, for management by others.

G. HASP Revisions

The HASP shall be maintained on-site by the Contractor and shall be kept current with construction activities and site conditions under this Contract. The HASP shall be recognized as a flexible document which shall be subject to revisions and amendments, as required, in response to actual site conditions, changes in work methods and/or alterations in the relative risk present. All changes and modifications shall be signed by the Contractor's HSM and shall require the review and acceptance by the Engineer prior to the implementation of such changes.

Should any unforeseen hazard become evident during the performance of the work, the HSO shall bring such hazard to the attention of the Contractor and the Engineer as soon as possible. In the interim, the Contractor shall take action, including Stop Work Orders and/or upgrading PPE as necessary, to re-establish and maintain safe working conditions and to safeguard on-site personnel, visitors, the public and the environment. The HASP shall then be revised/amended to reflect the changed condition.

Method of Measurement

A. Within thirty (30) calendar days of the award of the Contract, the Contractor shall submit to the Engineer for acceptance a breakdown of its lump sum bid price for this Item detailing:

1. The development costs associated with preparing the HASP in accordance with these Specifications.

2. The cost per month for the duration of the Project to implement the HASP and provide the services of the HSM and the HSO.

B. If the lump sum bid price breakdown is unacceptable to the Engineer, substantiation showing that the submitted costs are reasonable shall be required.

C. Upon acceptance of the payment schedule by the Engineer, payments for work performed will be made as follows:

1. The lump sum development cost will be certified for payment.

2. The Contractor shall demonstrate to the Engineer monthly that the HASP has been kept current and is being implemented and the monthly cost will be certified for payment.

3. Any month where the HASP is found not to be current or is not being implemented, the monthly payment for the Environmental Health and Safety Item shall be deferred to the next monthly payment estimate. If the HASP is not current or being implemented for more than thirty calendar days, there will be no monthly payment.

4. <u>Failure of the Contractor to implement the HASP in accordance with this Specification, shall result in the withholding of all Contract payments.</u>

Basis of Payment

This work shall be paid for at the Contract lump sum price for "ENVIRONMENTAL HEALTH AND SAFETY," which shall include all materials, tools, equipment and labor incidental to the completion of this Item for the duration of the Project to maintain, revise, monitor and implement the HASP. Such costs include providing the services of the HSM and HSO, Contractor employee training, CPC, PPE, disposal of PPE and CPC, medical surveillance, decontamination facilities, engineering controls, monitoring, and all other HASP protocols and procedures established to protect the Health and Safety for all on-site workers.

Pay Item	Pay Unit
Environmental Health and Safety	Lump Sum

ITEM #0101117A - CONTROLLED MATERIALS HANDLING

Description:

Work under this Item is intended to provide specific procedural requirements to be followed by the Contractor during the management of Controlled Materials excavated within the Project Limits that cannot be reused on the Project, as noted in the *Notice to Contractor – Environmental Investigations*. This supplements Specifications Sections 2.02, 2.03, 2.05, and 2.06, and Contract Special Provisions for excavation wherever contaminated materials are encountered.

All material excavated within the Project Limits, excluding existing pavement structure (asphalt and subbase), ballast, rock, ledge, and concrete, shall be reused on the Project unless deemed unsuitable by the Engineer due to physical indications of contamination or geotechnical characteristics of the material. Such unsuitable material, and surplus excavated material that cannot otherwise be reused on the Project, shall be staged on-site in a temporary waste stockpile area (WSA) depicted on Drawing ENV-002 in the Project Plans. The WSA shall be constructed and managed under *Item No. 0101128A - Securing, Construction and Dismantling of a Waste Stockpile and Treatment Area*. The Controlled Materials staged in the WSA will require disposal at an approved treatment/recycling/disposal facility in accordance with *Item No. 0202315A - Disposal of Controlled Materials*. Note that no excavated material may be reused once it has been transferred to the WSA.

Excavated material that is deemed suitable for reuse shall be managed at the point of origin for use as backfill. In instances where such material cannot be reused directly at the point of origin or within several days of excavation, the material shall be managed, in a manner approved by the Engineer, to minimize generation of fugitive dust and erosion, and prevent physical interference with other Project activities.

Materials:

The required materials shall conform to the requirements of the Contract.

Polyethylene sheeting for covering stockpiled excavated materials shall be a minimum thickness of 10 mils, 20 feet wide by 100 feet long.

Runoff control barrier shall be constructed with hay bales (14 inches by 36 inches by 18 inches, typical)

Sandbags used to secure polyethylene covers shall be at least 30 pounds.

Sorbent boom shall be eight inches in diameter and 10 feet long and possess petrophilic and hydrophobic properties. Sorbent booms shall also have devices (e.g., clips, clasps, etc.) for connection to additional lengths of boom.

Construction Methods:

A. General

When Controlled Materials are managed during the course of the work, health and safety provisions shall conform to the appropriate sections of the Contract. Provisions may include implementation of engineering controls, air and personal monitoring, the use of chemical protective clothing (CPC), personal protective equipment (PPE), and decontamination procedures.

Unless otherwise directed by the Engineer, at the time excavated materials are designated by the Engineer as unsuitable or surplus, that Controlled Material shall be transported directly from their point of origin on the Project to the WSA. That material shall be placed in the WSA bin and covered with polyethylene sheeting as shown on the Project Plans. The Contractor shall plan excavation activities in consideration of the material testing and disposal requirements of the applicable Contract item. **No claims for delay shall be considered based on the Contractor's failure to coordinate excavation activities as specified herein.**

The Engineer will sample the stockpiled Controlled Materials at a frequency and for the constituents to meet the acceptance criteria of the treatment/recycling/disposal facilities submitted by the Contractor. The Contractor is hereby notified that laboratory turnaround time is expected to be fifteen (15) working days. Turnaround time is the period of time beginning when the Contractor notifies the Engineer which facility it intends to use and that the bin within the WSA is full and is ready for sampling and ending with the Contractor's receipt of the laboratory analytical results. Any change of intended treatment/ recycling/disposal facility may prompt the need to resample and will therefore restart the time required for laboratory turnaround. The laboratory will furnish such results to the Engineer. Upon receipt, the Engineer will make available to the Contractor the results of the final waste characterization determination. **No claims for delay shall be considered based on the Contractor's failure to accommodate the laboratory turnaround time as identified above.**

B. Transportation and Stockpiling

In addition to following all pertinent federal, state and local laws or regulatory agency policies, the Contractor shall adhere to the following precautions during transport of non-hazardous Controlled Materials:

1. All vehicles shall have secure, watertight containers free of defects for material transportation;

2. No material shall leave the area of excavation until there is adequate lay-down area prepared in the WSA.

3. Bituminous concrete shall underlie all Controlled Materials in the WSA to ensure that seepage of material or water from the WSA is prevented. Measures shall be implemented to divert rainfall away from the WSA.

4. Placement of sorbent boom along the perimeter of the WSA shall be conducted when soil is saturated with petroleum product.

5. Excavated materials shall be staged as directed by the Engineer.

C. WSA Maintenance

The Contractor shall provide all necessary materials, equipment, tools, and labor for anticipated activities within the WSA. Such activities include, but are not limited to, handling and management of stockpiles and drummed CPC/PPE; uncovering and recovering stockpiles; maintenance of the WSA; replacement of damaged components (e.g., sand bags, polyethylene sheeting, anti-track pad, etc.); and waste inventory record management. The Contractor shall manage all soil and other materials handled in the WSA in such a way as to minimize tracking of potential contaminated materials across the Project site, the WSA, and off-site, and minimize dust generation.

Each stockpile shall be securely covered when not in active use, with a cover of sufficient size to prevent generation of dust and infiltration of precipitation. The polyethylene sheeting shall be secured with sandbags to prevent wind erosion.

The Contractor shall manage/stage stockpiled material within the WSA bin(s) as necessary, or otherwise directed by the Engineer, to ensure efficient use of bin space and enable effective maintenance of stockpile covers.

The staged stockpiles shall be inspected at least daily by the Contractor to ensure that the cover and containment have not been damaged and that there is no apparent leakage from the pile. If the cover has been damaged, or there is evidence of leakage from the piles, the Contractor shall immediately replace the cover or containment as needed to prevent the release of materials from the piles to the environment.

An inventory of stockpiled materials and drummed CPC/PPE shall be conducted on a daily basis. Inventory records shall indicate the approximate volume of material/drums stockpiled per day; the approximate volume of material/drums stockpiled to date; material/drums loaded and transported off-site for disposal; and identification of stockpiles relative to their points of generation.

Following the removal of all stockpiled Controlled Materials, residuals shall be removed from all surfaces of the WSA as directed by the Engineer. This operation shall be accomplished using dry methods such as shovels, brooms, mechanical sweepers or a combination thereof. Residuals shall be disposed of as Controlled Materials.

D. Dewatering

Dewatering activities shall conform to Items in pertinent articles of the Contract.

E. Decontamination

All equipment shall be provided to the work site free of contamination. The Engineer may prohibit from the site any equipment that in his opinion has not been thoroughly decontaminated prior to arrival. Any decontamination of the Contractor's equipment prior to arrival at the site shall be at the expense of the Contractor. The Contractor is prohibited from decontaminating equipment on the Project that has not been thoroughly decontaminated prior to arrival.

The Contractor shall furnish labor, materials, tools and equipment for decontamination of all equipment and supplies that are used to handle Controlled Materials. Decontamination shall be conducted at an area designated by the Engineer and may be required prior to equipment and supplies leaving the Project or between stages of the work.

Dry decontamination procedures are recommended. Residuals from dry decontamination activities shall be collected and managed as Controlled Materials. If dry methods are unsatisfactory as determined by the Engineer, the Contractor shall modify decontamination procedures as required, subject to the Engineer's approval.

F. Dust Control

The Contractor shall implement a fugitive dust suppression program in accordance with the Contract to prevent the off-site migration of particulate matter and/or dust resulting from excavation, loading and other handling operations associated with Controlled Materials. It shall be the Contractor's responsibility to supervise fugitive dust control measures and to monitor airborne particulate matter. The Contractor shall:

1. Employ reasonable fugitive dust suppression techniques.

2. Visually observe the amounts of particulate and/or fugitive dust generated during the handling of Controlled Materials. If the apparent amount of fugitive dust and/or particulate matter is not acceptable to the Engineer, the Engineer may direct the Contractor to implement corrective measures at his discretion, including, but not limited to, the following:

    a. Apply water to pavement surfaces;

    b. Apply water to equipment and excavation faces; and

    c. Apply water during excavation, loading, and dumping.

G. Permit Compliance

The Contractor shall comply with the terms and conditions of the CTDEEP *General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer)*, including the General Operating Conditions and the Specific Operating Conditions, except that the Engineer will conduct all soil/sediment characterization and perform all recordkeeping. In particular, the Contractor shall:

1. Operate, maintain and repair the existing temporary WSA in conformance with the requirements of the General Permit.

2. Maintain a communications system capable of summoning fire, police, and/or other emergency service personnel.

3. Separate incidental excavation waste (debris) to the satisfaction of the receiving facility or to an extent that renders the Controlled Materials suitable for its intended reuse.

4. Isolate and temporarily store incidental waste in a safe manner prior to off-site transport to a facility lawfully authorized to accept such waste.

5. Not store more than 100 cubic yards of incidental waste at any one time.

6. Sort, separate and isolate all hazardous waste from contaminated soil and/or sediment.

7. Prevent or minimize the transfer or infiltration of contaminants from the stockpiles to the ground as detailed in "B. Transportation and Stockpiling" above.

8. Securely cover each stockpile of soil as detailed in "C. WSA Maintenance" above.

9. Minimize wind erosion and dust transport as detailed in "F. Dust Control" above.

10. Install and use anti-tracking measures at the Project Site and at the WSA to ensure the vehicles do not track soil onto a public roadway at any time.

11. Instruct the transporters of contaminated soil and/or sediment of best management practices for the transportation of such soil (properly covered loads, removing loose material from dump body, etc.).

12. Control all traffic related to the operation of the facility in such a way as to mitigate the queuing of vehicles off-site and excessive or unsafe traffic impact in the area where the facility is located.

13. Ensure that except as allowed in section 22a-174-18(b)(3)(C) of the Regulations of Connecticut State Agencies, trucks are not left idling for more than three (3) consecutive minutes.

Method of Measurement:

The work of "CONTROLLED MATERIALS HANDLING" will be measured for payment by the number of cubic yards of unsuitable and/or surplus Controlled Materials excavated within the Project Limits and transported to the WSA. This measurement shall be in accordance with and in addition to the quantity measured for payment of the applicable excavation item in Specification Sections 2.02, 2.03, 2.05, 2.06, or the Contract Special Provisions, as applicable. Excess excavations made by the Contractor beyond the payment limits specified in the Contract will not be measured for payment and the Contractor assumes all costs associated with the appropriate handling, management and disposal of such material.

Equipment decontamination, the collection of residuals, and the collection and disposal of liquids generated during equipment decontamination activities will not be measured separately for payment.

Basis of Payment:

This work shall be paid for at the Contract unit price, which shall include: transportation from the excavation site to the WSA, including any intermediate handling steps; unloading, stockpiling and staging (as necessary) of Controlled Materials in the WSA; covering, securing, and maintaining the individual stockpiles within the WSA throughout the duration of the Project; and all tools, equipment, material and labor incidental to this work.

This price shall also include equipment decontamination; the collection of residuals generated during decontamination and placement of such material in the WSA; and the collection and disposal of liquids generated during equipment decontamination activities.

All materials, labor and equipment associated with compliance with the *General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer)* will not be measured separately but will be considered incidental to *Item No. 0101117A - Controlled Materials Handling*.

Pay Item	Pay Unit
Controlled Materials Handling	Cubic Yard

ITEM #0101128A - SECURING, CONSTRUCTION AND DISMANTLING OF A WASTE STOCKPILE AND TREATMENT AREA

Description:

Work under this Item shall consist of the securing, construction and dismantling of the temporary Waste Stockpile Area (WSA) at the location designated on Drawing ENV-002 of the Project Plans and in accordance with the Contract. The WSA is to be used exclusively for temporary stockpiling of unsuitable or surplus Controlled Materials associated with the Project for determination of disposal classification. It should be noted that the Site is located in a designated "Level A" Aquifer Protection Area (APA) and as such the WSA will have special location and construction provisions, as specified below. Further, relocation of the WSA may be required during the active project to accommodate sequencing of planned construction. The Contractor shall be prepared to accommodate deconstruction and relocation of the required WSA once during the Project.

Materials:

The required materials are further detailed on the Project Plans. All materials shall conform to the requirements of the Contract.

Construction blocks shall be solid precast rectangular concrete 6 feet in length, 3 feet in width, and 2 feet in height.

Ground surface within each WSA bin shall be constructed of semi-permanent impervious material (i.e., bituminous concrete) due to special provisions associated with the APA. In the event an existing impervious surface in good repair (i.e., no significant deterioration) is unavailable, the Contractor shall prepare a surface with the placement of three inches of Hot-Mix Asphalt (HMA) overlying six inches of process gravel.

Polyethylene sheeting for the covering of stockpiled soils shall be a thickness of 10 mils, 20 feet wide by 100 feet long.

Sand bags used to secure polyethylene sheeting soil covers shall have a minimum weight of thirty pounds.

Hay bales shall conform to the requirements of Section 2.18.02 of the Specifications.

Construction Methods:

The WSA shall initially be constructed in accordance with the Contract at the location depicted on Drawing ENV-002 of the Project Plans.

Construction of the WSA shall be completed prior to the initiation of construction activities generating Controlled Materials. The Contractor is responsible for the maintenance and protection of all utilities potentially affected during WSA construction. The Contractor shall locate and mark all existing utilities potentially affected prior to initiating WSA construction.

The proposed location of the WSA shall be cleared of any debris and vegetation, as directed by the Engineer, prior to construction of the WSA.

The Contractor shall comply with the terms and conditions of the CTDEEP *General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer*), including the General Operating Conditions and the Specific Operating Conditions, except that the Engineer will conduct all soil/sediment characterization and perform all record-keeping. In particular, the Contractor shall:

1. Construct and repair the WSA in conformance with the requirements of the General Permit.
2. Prevent unauthorized entry onto the stockpiles by the use of fences, gates, or other natural or artificial barriers.
1. Install anti-tracking measures at the WSA to ensure the vehicles do not track soil from the WSA to other portions of the Site or onto a public roadway at any time.

Following completion of Controlled Materials management activities and the removal of all stockpiled material, the Contractor shall use dry decontamination procedures for all surfaces of the WSA as directed by the Engineer. Residual materials shall be disposed of as Controlled Materials. If the results from dry methods are unsatisfactory to the Engineer, the Contractor shall modify decontamination procedures as required.

The Contractor shall be responsible for the collection and treatment/recycling/disposal of any liquid wastes that may be generated by its decontamination activities in accordance with applicable regulations.

Upon completion of the Project and following removal of all residual Controlled Materials, the Contractor shall dismantle the WSA and return the area to original condition. During dismantling, the Contractor shall remove all materials such as polyethylene sheeting and sand bags. Materials shall be disposed of by the Contractor as solid waste in accordance with the Contract and all Federal, State and local regulations.

Operation and maintenance of the WSA shall be included under *Item 101117A - Controlled Material Handling*.

Method of Measurement:

This work will be measured for payment at the Lump Sum cost for securing, construction, and dismantling of a WSA. Note that, due to potential Project phase sequencing, the WSA may require relocation from the designated location on Drawing ENV-002, to a different location to be determined by the Engineer. The Contractor shall include the provision for one relocation of the WSA in the Item cost.

Basis of Payment:

This work will be paid for at the Contract Lump Sum, which shall include all materials, tools, labor, equipment, permits, and work needed to secure, construct, decontaminate and dismantle the

WSA, including all clearing, grubbing, grading, clean up, site restoration and seeding. Payment under this Item shall include all such activities associated with one relocation event for the WSA.

All materials, labor and equipment associated with compliance with the *General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer)* will not be measured separately, but will be considered incidental to the Item "Securing, Construction and Dismantling of a Waste Stockpile and Treatment Area".

Pay Item	Pay Unit
Securing, Construction and Dismantling Of a Waste Stockpile and Treatment Area	Lump.Sum.

ITEM #0101143A – HANDLING AND DISPOSAL OF REGULATED ITEMS

Description:

Work under this item shall include the management (handling and disposal) of regulated items and all associated work by persons who are employed by a Connecticut Department of Energy and Environmental Protection (CTDEEP) permitted Spill Contractor and trained/certified in accordance with OSHA Hazard Communication regulations. Regulated items include hazardous and other materials and wastes, the disposal of which is restricted by Federal and/or State laws and regulations, and which may be a component of equipment or other items located on-site. Regulated items include those listed herein, or additional similar items identified on site by the Engineer. Work under this item does not include asbestos containing materials, lead paint, contaminated or hazardous soils.

Activities shall be performed in accordance with, but not limited to, the current revision of the USEPA & CTDEEP Hazardous Waste Regulations (40 CFR 260-282, 22a-209 and 22a-449(c)), USEPA PCB Regulations (40 CFR 761), USEPA Protection of Stratospheric Ozone (40 CFR 82), OSHA Hazard Communication (29 CFR 1910.1200), OSHA Hazardous Waste & Emergency Response Regulations (29 CFR 1910.120), USDOT Hazardous Materials Regulation (49 CFR 171-180), OSHA, RCRA, CERCLA, CAA, TSCA, and all other laws and regulations.

The work activities include the removal, handling, packing, labeling, transport, manifesting, and recycling or disposal of various regulated items at the Project site prior to beginning planned construction activities.

The Contractor is solely responsible for verifying actual locations and quantities of the items with hazardous/regulated material/waste constituents and for their proper handling and disposal. The recycling or proper disposal, as appropriate, of all regulated items shall be completed prior to the initiation of any construction activities.

Materials:

All materials shall be suitable for the management of regulated items and shall meet all applicable federal, state and local regulations. Such materials include, but are not limited to, proper containers, packing materials, labels, signs, shipping papers, personnel protective equipment (PPE) and spill kits.

Construction Methods:

(1) Allowable Disposal/Recycling Facilities

Disposal facilities for RCRA-hazardous, TSCA-hazardous, Connecticut Regulated, and Universal wastes shall be chosen from among those listed below. No other facility shall be used for these types of wastes without the written approval of the Engineer.

AVC (aka Cycle Chem) 217 South First Street, Elizabeth, NJ 07206 Phone: (908) 354-0210 Fax: (908) 355-0562 RCRA, TSCA liquid and solid	Advanced Disposal (Managed by Interstate Waste Services) 7095 Glades Pike Summerset, PA 15501 Phone: (814) 444-0112 Fax: (814) 444-0127 MSW, C&D debris, residual waste, sewage sludge, incinerator ash, asbestos
Advanced Disposal Services Greentree Landfill* 635 Toby Road Kersey, PA 15846 Phone: (814) 265-1744 Fax: (814) 265-8745 MSW, C&D, asbestos, PCB remediation waste <50 ppm, petroleum contaminated soils, nonhazardous solid wastes	Allied Waste Niagara Falls Landfill, LLC 5600 Niagara Falls Blvd. Niagara, NY 14304 Phone: (716) 285-3344 Fax: (716) 285-3398 Non-hazardous waste, industrial solid waste, municipal sewage treatment sludge, contaminated soil & debris, asbestos waste, C&D debris, industrial process sludge
American Lamp Recycling, LLC 26 Industrial Way Wappingers Falls, NY 12590 Phone: (845) 896-0058 Fax: (845) 236-9277 Mercury containing devices, universal waste	Clean Earth of Carteret 24 Middlesex Ave.~~,~~ Carteret, NJ 07008 Phone: (732) 541-8909 Fax: (732) 541-8105 Concrete, brick, block, street sweepings, stone, rock, asphalt and petroleum contaminated soil
Clean Earth of Connecticut (aka Phoenix Soil) 58 North Washington Street Plainville, CT 06062 Phone: (860) 747-8888 Fax: (203) 757-4933 Contaminated soil	Clean Earth of North Jersey, Inc. (aka CENJ) 115 Jacobus Ave, South Kearny, NJ 07105 Phone: (973) 344-4004 Fax: (973) 344-8652 RCRA liquid and solid, asbestos
Clean Earth of Philadelphia, Inc. 3201 S. 61 Street Philadelphia, PA 19153 Phone: (215) 724-5520 Fax: (215) 724-2939 Petroleum contaminated soils	Clean Earth of Southeast Pennsylvania, Inc. 7 Steel Road, Morrisville, PA 19067 Phone: (215) 428-1700 Fax: (215) 428-1704 Petroleum contaminated soil
Clean Harbors Environmental Services, Inc. 2247 South Hwy. 71, Kimball, NE 69145 Phone: (308) 235-4012 Fax: (308) 235-4307 RCRA liquid, solid & sludge	Clean Harbors of Baltimore, Inc. 1910 Russell St, Baltimore, MD 21230 Phone: (410) 244-8200 Fax: (410) 752-2647 RCRA liquid: aqueous organic & inorganic wastewater

Clean Harbors of Braintree, Inc. 1 Hill Avenue Braintree, MA 02184 Phone: (781) 380-7100 Fax: (781) 380-7193 RCRA, TSCA & CRW Gas, Liquid, Solid, Sludge	Clean Harbors Environmental Services, Inc. Cleveland Facility 2900 Rockefeller Ave.~~,~~ Cleveland, OH 44115 Phone: (216) 429-2401 Fax: (216) 429-1713 RCRA liquid: aqueous organic & inorganic wastewater
Clean Harbors of Connecticut, Inc. 51 Broderick Road Bristol, CT 06010 Phone: (860) 583-8917 Fax: (860) 585-1740 RCRA TSCA & CRW Gas, Liquid, Solid, Sludge	Clean Harbors Environmental Services, Inc. Spring Grove Facility 4897 Spring Grove Avenue Cincinnati, OH 45232 Phone: (513) 681-6242 Fax: (513) 681-0869 RCRA aqueous organic and inorganic wastewaters, RCRA hazardous wastes, PCB wastewater treatment
Clean Harbors of Woburn (Murphy's Waste Oil Serv., Inc.) 252 Salem Street Woburn, MA 01801 Phone: (781) 935-9066 Fax: (781) 935-8615 RCRA, CRW: Oil, Oil/Water Mixtures, Oil Filters, Oily Soil and Debris, F001/F002 Contaminated Oils, Antifreeze	Clinton Landfill 242 Church Street Clinton, MA 01510 Phone: (978) 365-4110 Fax: (978) 365-4106 Comm-97 Soils
Colonie Landfill (Waste Connections, Inc.) 1319 Loudon Rd, Cohoes, New York 12047 Phone: (518) 783-2827 Fax: (518) 786-7331 Non-hazardous wastes, special wastes, contaminated soil	Cumberland County Landfill 135 Vaughn Road, Shippensburg, PA 17257 Phone: (717) 729-2060 Fax: (717) 423-6822 MSW, non-hazardous waste
Dudley Reclamation Project (W.L. French Excavating) 23 Oxford Avenue Dudley, MA Phone: 978) 663-2623 Fax: (978) 663-5240 MADEP RCS-1 and RCS-2 compliant soils	Envirite of PA 730 Vogelsong Road, York, PA 17404 Phone: (717) 846-1900 Fax: (717) 854-6757 RCRA hazardous wastes

Environmental Quality Company: Wayne Disposal Facility (aka EQ Michigan Disposal Waste Treatment Plant and Wayne Disposal Inc. Site #2) 49350 North I-94 Service Drive Belleville, MI 48111 Phone: (734) 697-2200 Fax: (734) 699-3499 RCRA & TSCA liquid and solid	Environmental Soil Management of New York, LLC (ESMI of New York) 304 Towpath Road, Fort Edward, NY 12828 Phone: (518) 747-5500 Fax: (518) 747-1181 Petroleum contaminated soil Non-hazardous wastewater
Environmental Soil Management of NH 67 International Dr. Loudon, NH 03307 Phone: (603) 783-0228 Fax: (603) 783-0104 Petroleum contaminated soil	Globalcycle, Inc. 700 Richmond Street Unit #4 East Taunton, MA 02718 Phone: (508) 828-1005 Fax: (508) 824-2486 non-hazardous wastewater
Hazelton Creek Properties, LLC* (Hazelton Mine Reclamation Project) 280 South Church St., Hazelton, PA 18201 Phone: (570) 501-5050 Fax: (570) 457-3395 Fresh, brackish or marine dredge material, coal ash, cement kiln dust, lime kiln dust, co-generator ash, regulated fill	Heritage Hazardous Waste Landfill (Heritage Environmental Services, LLC) 4370 W County Rd 1275 N Roachdale, IN 46172 Phone: (315) 406-9342 Fax: NA Hazardous Wastes, Asbestos
Manchester Landfill 311 Olcott Street Manchester, CT 06040 Phone: (860) 647-3248 Fax: (860) 647-3238 MSW, non-haz waste, cont. soil, non-friable ACM	Northeast Lamp Recycling, Inc. 250 Main Street, East Windsor, CT 06088 Phone: (860) 292-1992 Fax: (860) 292-1114 CRW solid waste, mercury containing devices & universal waste
Ontario County Landfill (Managed by Casella Waste) 3555 Post Farm Road, Stanley, NY 14561 Phone: (585) 526-4420 Fax: (585) 526-5459 MSW, non-haz waste (solids), special wastes including asbestos, ash from boilers/ incinerators, cont, demo debris	Paradise Heating Oil, Inc. Quimby Street, Ossining, NY 10562 Phone: (631) 926-2576 Fax: (718) 294-2226 CRW waste oil liquid

Red Technologies Soil 232 Airline Avenue Portland, CT 06980 Phone: (860) 342-1022 Fax: (860) 342-1042 Temporary storage and transfer of contaminated soil	Republic Services Conestoga Landfill* 420 Quarry Road Morgantown, PA 19543 Phone: (610) 286 – 6844 Fax: (610) 286-7048 MSW, C&D debris, residual waste, contaminated soil, asbestos
Soil Safe, Inc. 378 Route 130, Logan Township, Bridgeport NJ 08085 Phone: (410) 872-3990 Fax: (410) 872-9082 Soil contaminated with petroleum or metals, some industrial waste solids	The Southbridge Recycling and Disposal Park 165 Barefoot Road Southbridge, MA 01550 Phone: (603) 235-3597 (Scott) Fax: (508) 765-6812 MSW, C&D, cont. soil for cover
Stablex Canada, Inc. 760 Industrial Blvd. Blainville Quebec J7C 3V4 Phone: (450) 430-9230 Fax: (450) 430-4642 RCRA liquid and solid, industrial wastes	Stericycle (aka PSC Environmental Syst) 275 Allens Ave Providence, RI 02905 Phone: (401) 781-6340 Fax: (401) 781-9710 RCRA Liquid and Solid Organics, Oils, Solvents, Pesticides, Chlorinated Hydrocarbons, empty drums
Stericycle (Republic Environmental Systems) * 2869 Sandstone Dr., Hatfield PA 19440 Phone: (215) 822-2676 Fax: (215) 822-1293 RCRA & TSCA industrial solid & sludge, aqueous waste, contaminated soil, PCB waste, oil & petroleum waste, organic waste	Ted Ondrick Company, LLC 58 Industrial Road, Chicopee, MA 01020 Phone: (413) 592-2566 Fax: (413) 592-7451 Petroleum contaminated soil
Tradebe Environmental Services, Inc. 136 Gracey Avenue Meriden, CT 06451 Phone: (888) 276-0887 Fax: (203)238-6772 RCRA, CRW Waste Oil, Fuel, Wastewater	Tradebe Environmental Services, Inc. 50 Cross Street Bridgeport, CT 06610 Phone: (888) 276-0887 Fax: (203)238-6772 RCRA and CRW Waste Oil, Fuel, Wastewater
Triumvirate 263 Howard Street, Lowell, MA 01852 Phone: (978) 453-7772 Fax: (978) 453-7775 RCRA & TSCA liquid and solid	Tunnel Hill Reclamation 2500 Township Road, 205 Route 2 New Lexington, OH 43764 Phone: (914) 713-0203 Fax: (914) 713-0672 Municipal solid waste, non-hazardous waste, contaminated soils

Waste Management of New Hampshire (Turnkey Landfill) P.O. Box 7065 90 Rochester Neck Road Rochester, NH 03839 Phone: (603) 330-2170 Fax: (603) 330-2130 MSW, C&D, PCB remediation waste (<50 ppm), virgin petroleum contaminated soil, CRW solid waste	US Ecology (EQ Detroit) 1923 Frederick Street Detroit, MI 48211 Phone: (313) 347-1300 Fax: (313) 923-0217 RCRA hazardous and non-hazardous wastewater
Waste Management: RCI Fitchburg Landfill 101 Fitchburg Princeton Road Westminster, MA 01473 Phone: (978) 355-6821 Fax: (978) 355-6317 MSW, non-hazardous waste, C&D, contaminated soil for use as cover material under MADEP COMM-97 policy, treated lumber, asbestos	
CRW – Connecticut Regulated Waste; C&D – Construction and Demolition; MSW - Municipal Solid Waste	

* - Please note that if this facility is to be used, each waste determination letter will require an additional 10 days (or more) waiting period on top of the 15-day lab period designated in the Specifications to allow for Pennsylvania Department of Environmental Protection (PADEP) review

The category of material accepted by each facility listed above is for informational purposes only. The Contractor shall verify facility acceptance of each type of regulated item.

(2) Submittals

Thirty (30) days prior to commencement of work involving the management of regulated items, the Contractor shall submit to the Engineer for approval, the following documentation:

1. Copy of Spill Contractor Permit registration issued by the CTDEEP.
2. Ozone depleting substance service technician certification (as applicable).
3. Hazard communication training for all employees performing this work.
4. Names of the treatment facilities, recycling facilities and/or disposal facilities the Contractor intends to use to receive each type of regulated item.
5. Hazardous Material Transporter USDOT Certificate of Registration for each transporter.
6. Hazardous Waste Transporter Permit for the State of Connecticut, the destination state(s), and all other applicable states for each transporter.
7. Request for an EPA Hazardous Waste Generators ID number, for use in manifesting hazardous waste above conditionally exempt small quantities (as applicable).

Contractor shall provide the Engineer with a minimum of 48 hours notice in advance of scheduling, changing or canceling work activities.

(3) Regulated Item Management Provisions

(a) General Requirements

The Contractor's OSHA Competent Person shall be in control on the job site at all times during hazardous material management work activities. This person must be capable of identifying existing hazards, possess the authority to implement corrective measures to reduce/eliminate the hazards, comply with applicable Federal, State and Local regulations that mandate work practices, and be capable of performing the work of this contract. All employees who perform regulated material management related work shall be properly trained and qualified to perform such duties.

All labor, materials, tools, equipment, services, testing, insurance, and incidentals which are necessary or required to perform the work in accordance with applicable governmental regulations, industry standards and codes, and these specifications, shall be provided by the Contractor.

Ladders and/or scaffolds shall be in compliance with OSHA requirements, and of adequate length, strength and sufficient quantity to support the scope of work. Use of ladders/scaffolds shall be in conformance with OSHA 29 CFR 1926 Subpart L and X requirements.

Work performed at heights exceeding six feet (6') shall be performed in accordance with the OSHA Fall Protection Standard 29 CFR 1926 Subpart M including the use of fall arrest systems as applicable.

The Contractor shall be responsible for verification of all field conditions affecting performance of the work. The Contractor shall submit to the Engineer for concurrence any additional items not listed herein that it believes to be regulated items included under this item. However, compliance with applicable requirements is solely the responsibility of the Contractor.

The Engineer will provide a Project Monitor to monitor the activities of the Contractor and inspect the work required. Environmental sampling shall be conducted as deemed necessary by the Engineer. Spill areas shall be cleaned by the Contractor until accepted by the Engineer. The Engineer may sample the spill area to demonstrate Contractor compliance with an acceptable standard.

(b) Personnel Protection

Prior to commencing work, the Contractor shall provide hazard communication training to all employees as necessary in accordance with OSHA 29 CFR 1926.59 and 29 CFR 1910.1200 and instruct all workers in all aspects of personnel protection, work procedures, emergency procedures and use of equipment including procedures unique to this project. Worker health and safety protocols that address potential and/or actual risk of exposure to site specific hazards are solely the responsibility of the Contractor.

The Contractor shall provide respiratory protection that meets the requirements of OSHA as required in 29 CFR 1910.134 and 29 CFR 1926.1000. A formal respiratory protection program,

including appropriate medical surveillance, must be implemented in accordance with OSHA standards. The Contractor shall, as necessary, conduct exposure assessment air sampling, analysis and reporting to ensure the workers are afforded appropriate respiratory protection.

The Contractor shall provide and require all workers to wear appropriate personnel protective equipment, including protective clothing and respiratory protection, as required, within regulated work areas which exceed OSHA Personnel Exposure Limits (PELs) or when handling hazardous materials.

(c) Regulated Item Management Work Procedures

The Contractor shall not begin work until the Project Monitor is on-site.

Prior to beginning work on-site, the Contractor shall prepare waste characterization profile forms for each type of waste stream to be generated and forward such forms to the Engineer for review, approval and signature. Upon approval, the Contractor shall forward such forms to the appropriate disposal facilities for acceptance.

The Contractor shall utilize all appropriate engineering controls and safety and protective equipment while performing the work in accordance with OSHA, USEPA, USDOT, CTDEEP and Connecticut Department of Public Health (DPH) regulations.

The Contractor shall employ work practices so as to minimize the disturbance of the constituents in the regulated items, and prevent breakage and spills. In the event of a spill, the Contractor shall cordon off the area and notify the Engineer. The Contractor is responsible to have spills and the effected areas decontaminated to the acceptance of the Engineer by personnel trained in hazardous waste operator emergency response.

The Contractor shall carefully and properly remove, handle, pack, label and manifest all of the regulated items in waste containers specified and suitable to contain the waste in accordance with all federal and state regulations.

Prior to transportation and recycling and/or disposal, all proper USEPA, OSHA, CTDEEP and USDOT labels and placards shall be affixed to the waste containers and hazardous materials shipping papers such as waste manifests/bills of lading shall be completed.

Prior to construction activities, properly remove, handle, pack, label, transport, manifest and recycle or dispose of the regulated items from those listed below:

The following hazardous/regulated materials, wastes and items have been identified at the Putnam Maintenance Facility, 3 Industrial Park Road, Putnam, Connecticut.

- **RCRA Ignitables – Gasoline waste products from UST removal (gasoline)**
- **Connecticut Regulated Waste (CRW) – Waste chemical liquids from AST/UST/OWS removals (motor oil, fuel oil, diesel, sludge)**
- **Connecticut Regulated Waste (CRW) – Waste chemical liquids from floor trench/basin cleanout (oils/sludge)**

- **Connecticut Regulated Waste (CRW) – Waste chemical liquids from hydraulic lift piston/tank removals (hydraulic fluid)**
- **Connecticut Regulated Waste (CRW) – Wastewaters generated from dewatering activities directed by the Engineer in efforts to achieve compliance with the UST Regulations**[1]
- **Connecticut Regulated Waste (CRW) – PCB/DEHP oil filled Light Ballasts**
- **Universal Waste (UW) – Mercury - Fluorescent Lamps, Halogen Lamps, HID Lamps, Mercury Vapor Bulbs, Emergency Lights, CFLs, Thermostat Ampules, Thermometers**
- **Universal Waste (UW) – Used Electronics - Printed Circuit Boards from Thermostats, Electronic Light Ballasts, Emergency Lights, Electronic Smoke Detectors, UST Management System Controls, Control Panel Boards, Exit Signs, Electrical Meter**
- **Universal Waste (UW) – NiCad, Li, Pb-Acid Batteries from Emergency Lights**
- **CFCs/Freon – Water Fountains, AC units**
- **Low Level Radioactive Waste (LLRW) – Smoke Detectors**

[1]Excludes any wastewaters generated during general construction activities, which would be addressed under a CTDEEP General Discharge Permit.

Upon discovery of any previously unidentified regulated items during construction activities, the Contractor shall immediately notify the Engineer and work shall cease in that area until the Engineer can determine the extent of any impact and proper handling procedures are implemented.

(d) Waste Disposal

Efforts shall be made to recycle the constituents of the regulated items rather than dispose of them in accordance with the waste minimization efforts required under RCRA.

RCRA hazardous waste shall not be stored on the job site in excess of 90 calendar days from the accumulation start date.

Connecticut Regulated Waste shall not be transported to a RCRA or TSCA permitted facility for disposal, unless otherwise allowed by the Engineer in writing.

All non-RCRA hazardous waste materials, regulated waste materials and recyclable waste items shall be manifested separately from RCRA and TSCA hazardous waste, and documented properly on non-hazardous waste manifests, waste shipment records, bills of lading or other appropriate shipping papers for transportation to the recycling and/or disposal facility.

The Contractor shall prepare each lab pack list and shipping document (manifests, waste shipment records, bills of lading, etc.) with all of the required information completed (including types of waste, proper shipping name, categories, packing numbers, amounts of waste, etc.) in accordance with applicable federal and state regulations. The document will be signed by an authorized agent representing ConnDOT as the Generator for each load that is packed to leave the site.

The Contractor shall forward the appropriate original copies of shipping papers to the Engineer the same day the regulated items leave the Project site.

All vehicles departing the site transporting hazardous materials shall display proper USDOT placards, as appropriate for the type of waste being transported.

(e) Project Closeout Documents:

Within thirty (30) days after completion of the on-site project work, the Contractor shall submit to the Engineer copies of the following completed documents:

1. Hazardous Waste Manifests
2. Waste Shipment Records/Bills of Lading
3. Recycling Receipts

Documents 1. through 3. must include the signature of an authorized disposal facility representative acknowledging receipt of hazardous materials.

Method of Measurement:

The work of "Handling and Disposal of Regulated Items" shall be provided for in accordance with Article 1.04.05 – Extra Work.

Basis of Payment:

The work of Handling and Disposal of Regulated Items shall be paid for in accordance with Article 1.04.05 – Extra Work, which price shall include the management, removal, handling, packing, labeling, transport, manifesting, recycling or disposal of the regulated constituents in the specific equipment/items scheduled for impact at the Project site, and all equipment, materials, tools and labor incidental to the work.

Final payment will not be made until completed copies of all Manifest(s), Waste Shipment Records, Bills of Lading and/or Recycling Receipts have been provided to the Engineer. Once completed and facility-signed copies have been received in their entirety, the Engineer will make the final payment.

Pay Item	Pay Unit
Handling and Disposal of Regulated Items	Estimated

ITEM #0101183A – PCB BUILDING MATERIALS REMOVAL

Description:

This work shall be conducted at the Putnam Maintenance Facility, Putnam, Connecticut.

Work under this item shall include the abatement of: PCB-containing caulk and glazing (Federally-regulated and/or non-federally/state regulated PCB) and removal of abutting building materials (e.g. concrete/block, brick, metal door/window framing, window pane glass, wood, etc.) as identified in the Contract Plans and PCB Site Remedial Plan, that are coated with or impacted by PCB-containing caulk and/or glazing ("PCB Waste").

The work shall be performed by persons who are knowledgeable, qualified, trained and licensed in the removal, treatment, handling, and disposal of PCB contaminated wastes and the subsequent cleaning of the affected environment. Where areas to be abated contain materials with PCBs and asbestos the workers shall also have all the required asbestos licensing/training as required in Specification Section 0020801A.

These Specifications govern all work activities that disturb PCB-containing caulk and glazing and associated building material. All activities shall be performed in accordance with, but not limited to, OSHA Regulation 29 CFR 1926, EPA PCB Regulation 40 CFR Part 761, CTDEEP PCB Statutes 22a-463 through 22a-469 inclusive, and CTDEEP Remediation Standards Regulations 22a-133k-1 through 3, where applicable.

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to this work.

This Specification will be utilizing the *PCB Bulk Product Waste Reinterpretation Memorandum* issued October 24, 2012 to designate building material (i.e. substrate) "coated or serviced" with PCB Bulk Product Waste at the time of designation for disposal to be managed as a PCB Bulk Product Waste. Therefore, any PCB Remediation Waste (>1 ppm) generated during this abatement (brick, concrete, CMU, metal door/window framing, wood, etc) will be disposed of as PCB Bulk Product Waste (>50 ppm) as these building materials are still "coated or serviced" with the PCB Bulk Product Waste.

Abatement work shall include the removal, transportation, and disposal of all PCB Wastes as identified on the Contract Documents, the PCB Site Remedial Plan and Specifications prior to any phased or planned renovation/demolition work involving the subject PCB areas. All PCB abatement material shall be disposed of by the Contractor as PCB Bulk Product Waste and/or CTDEEP State Regulated waste in accordance with 40 CFR Part 761 and/or 22a-463 through 469 as applicable.

Deviations from these Specifications require the written approval from the Owner.

Materials:

All materials shall be delivered to the job site in the original packages, containers, or bundles bearing the name of the manufacturer, the brand name and product technical description.

No damaged or deteriorating materials shall be used. If material becomes contaminated with PCBs, the material shall be disposed of as PCB waste material. The cost to dispose of this material shall be at the expense of the Contractor.

Fire retardant polyethylene sheet shall be in roll size to minimize the frequency of joints, with factory label indicating six (6) mil thickness.

Tape (or equivalent) capable of sealing joints in adjacent polyethylene sheets and for the attachment of polyethylene sheets to finished or unfinished surfaces must be capable of adhering under both dry and wet conditions.

Containers for storage, transportation and disposal of PCB-containing waste material shall be impermeable and both air and watertight.

Labels and warning signs shall conform to OSHA 29 CFR 1926, USEPA 40 CFR Part 761, CTDEEP 22a-463 through 469, and USDOT 49 CFR Part 172 as appropriate.

Any planking, bracing, shoring, barricades and/or temporary sheet piling, necessary to appropriately perform work activities shall conform to all applicable federal, state and local regulations.

Air filtration devices and vacuum units shall be equipped with HEPA filters.

The Contractor shall deliver and store materials in a manner to prevent contamination, segregation, freezing, and other damage.

Construction Methods:

(1) Pre-Abatement Submittals and Notices

Submit the following documentation to ensure compliance with the applicable regulations. An up to date copy shall be retained at the job site at all times. Submission must be made prior to the Pre-abatement Meeting, which will be held prior to the start of abatement at the Engineers direction. The Abatement Contractor, PCB Engineer, and Owner's Representatives shall be present at the meeting.

(a) The following must be provided to the Owner, Construction Administrator, and the PCB Engineer seven (7) days prior to starting work.

1. As related to the PCB abatement work, site-specific Health and Safety Plan including the Emergency Response Plan and provisions for decontamination and a contingency plan for unforeseen emergencies. The Owner or PCB Engineer shall review such a plan only to determine if the plan meets basic regulatory requirements and the minimum requirements of these Specifications. The review will not determine the adequacy of the plan to address all potential hazards, as that remains the sole responsibility of the Contractor.

2. A Contractor Site PCB Work Plan describing the containment and air monitoring that will be employed during abatement activities. This work plan should also include information on how and where wastes will be stored and disposed of, and on how field equipment will be decontaminated.

3. Current certification of employee's OSHA health and safety training (HAZWOPER).

4. Certification of additional required health and safety training for Supervisors.

5. Qualifications and experience of the Site Safety Officer (SSO)

(b) Seven (7) days prior to any worker accessing the site to perform the work described in this Section, the Contractor shall provide documentation, typed on company letterhead and signed by the Contractor, certifying that all employees assigned to the PCB abatement work listed therein have received the following:

1. Medical monitoring within the previous twelve (12) months, as required in 29 CFR 1910.120.

2. Respirator fit testing within the previous twelve (12) months as detailed in 29 CFR 1910.134 (for all employees who must also don a tight-fitting face piece respirator).

(c) At least seven (7) days prior to performing any abatement work that shall generate PCB wastes, the Contractor shall submit copies of the EPA/State-approved permits for the proposed Solid Waste, Chemical Waste, or Hazardous Waste landfills and/or high temperature incinerator and a waste profile approved by the proposed landfill/incinerator indicating that the waste materials to be generated are acceptable to the facility.

(d) Seven (7) days prior to the start of abatement work, material information for any proposed encapsulant indicating that these materials conform to the specifications contained within, if applicable.

(e) No abatement shall commence until a copy of all required submittals have been received and found acceptable to the Owner and the PCB Engineer. Those employees added to the

Contractor's original list will be allowed to perform work only upon submittal, and receipt of, all the above required paperwork to the Owner and PCB Engineer.

(f) Copies of all permits, licenses, certifications, including but not limited to, manifests and/or bill of lading for the removal, transport, and disposal of PCB waste material shall be submitted to the Owner and PCB Engineer no later than seven (7) business days after the Contractor receives such documents.

(g) Notice shall be provided to the Owner and the PCB Engineer at least seven (7) business days prior to the start of work under this Specification. Such notice shall include an estimated completion date. If this work is phased over the duration of the project, then such notification requirements shall apply to each phase.

(2) PCB Abatement Provisions:

(a) General Requirements for PCB Building Materials Removal

All labor, materials, tools, equipment, services, testing, insurance, and incidentals which are necessary or required to perform the work in accordance with applicable governmental regulations, industry standards and codes, and these Specifications shall be provided by the Contractor. The Contractor shall be prepared to work all shifts and weekends throughout the course of this work.

Prior to beginning work per these Specifications, the PCB Engineer and Contractor shall perform a visual survey of each work area and review conditions at the site for safety reasons. In addition, the Contractor shall instruct all workers in all aspects of personnel protection, work procedures, emergency evacuation procedures and use of equipment including procedures unique to this work.

Prior to the performance of any abatement work, the Contractor shall perform the following tasks.

Shutdown and isolate heating, cooling, and ventilating air systems to prevent contamination to the other areas of the buildings.

Shut down and lock out electrical power, including all receptacles and light fixtures, when feasible. The use or isolation of electrical power will be coordinated with all other ongoing uses of electrical power at the site.

Coordinate all power and fire alarm isolation with the appropriate representatives.

When necessary, provide temporary power and adequate lighting and ensure safe installation of electrical equipment, including ground fault protection and power cables, in compliance with applicable electrical codes and OSHA requirements. The Contractor is responsible for proper connection and installation of electrical wiring.

If sufficient electrical service is unavailable, the Contractor may need to supply electrical power to the site by fuel operated generator(s). Electrical power supply shall be sufficient for all equipment required for this work in operation throughout the duration of the work.

Negative pressure must be maintained in each active interior work area, until the area achieves satisfactory verification and reoccupancy criteria and is approved by the Project Monitor to be deregulated.

Water service may not be available at the site. Contractor shall supply sufficient water for each shift to operate the decontamination units as well as to maintain the work areas adequately wet.

Ladders and/or scaffolds shall be in compliance with OSHA requirements, and of adequate length, strength and sufficient quantity to support the scope of work. Use of ladders/scaffolds shall be in conformance with OSHA 29 CFR 1926 Subpart L and X requirements.

Work performed at heights exceeding six feet (6') shall be performed in accordance with the OSHA Fall Protection Standard 29 CFR 1926 Subpart M including the use of fall arrest systems as applicable.

The Contractor shall protect adjacent structures and surfaces from traffic or any other damage. The Contractor shall repair and reestablish damaged building materials that are to remain in place prior to acceptance of the work.

Data provided regarding PCB sampling conducted throughout the structure(s) is for informational purposes only. Under no circumstances shall this information be the sole means used by the Contractor for determining the presence, location and extent/quantity of all PCB Waste. The Contractor shall verify all field conditions and quantities affecting performance of the work as described in these Specifications and the PCB Site Remedial Plan in accordance with applicable OSHA, USEPA, USDOT, and CTDEEP standards. Compliance with the applicable requirements is solely the responsibility of the Contractor.

The PCB Engineer will provide a Project Monitor to oversee the activities of the Contractor. No PCB abatement work shall be performed until the Project Monitor is on-site.

(b) Definitions

<u>Contaminant Zones</u>

Contaminant zones are those areas of active abatement and the waste storage area.

<u>Abatement</u>

The removal of PCB contaminated caulks/glazes and associated building materials in the manner specified in this section.

Federally-Regulated PCB Bulk Product Wastes

Federally-regulated PCB Bulk Product Waste, as defined in §761.3, means 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 ≥50 ppm PCBs.

Non-federally or State Regulated PCB Waste

Non-federally or state regulated PCB waste means 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 >1 ppm and < 50 ppm PCBs.

PCB Waste

PCB waste means PCB-containing caulk and glazing (Federally-regulated and non-federally or state regulated PCB) and impacted abutting building materials to the subject caulk and glazing.

PCB Site Remedial Plan

Item 0101183 – PCB Building Materials Removal

Remedial Action Level

Concentration to which PCB contaminated building materials must be removed to verify completion of the abatement work.

PCB Contaminated Building Materials

Consists of those caulks and glazings identified as PCB Bulk Product Wastes and/or non-federally/state regulated materials. Also may include the building materials in which the caulks and glazings are in contact with which may include, but not limited to, window/door frames, glass, brick, concrete, CMU, mortar, metal, wood, etc.

Suitable Waste Storage Container

A container in which PCB wastes are placed for storage prior to transport offsite for disposal that is water tight, lined, and equipped with a cover that prevents the infiltration of rainwater into the container.

Verification and Reoccupancy Sampling

Sampling performed by the Project Monitor to determine the completion of abatement activities as per the PCB Site Remedial Plan.

Waste Storage Area

The secured location in which the Contractor shall store PCB wastes prior to offsite transport for disposal. The Contractor shall consult with the Owner and the PCB Engineer to identify the location of Waste Storage Areas prior to generating any wastes. This area shall be secured and signed by the Contractor.

PCB Engineer

Responsible for overseeing PCB abatement work and for performing and evaluating verification and reoccupancy sample data on behalf of the Owner. The PCB Engineer shall be represented daily onsite by the Project Monitor.

Owner

The Owner is the Connecticut Department of Transportation (ConnDOT), as further defined in the General Conditions.

Project Monitor

The onsite representative for the PCB Engineer responsible for overseeing daily work activities. The Project Monitor shall approve all containments prior to performance of abatement work; perform sampling during and after abatement activities, and for verifying that abatement has been successfully performed and allowing containments to be removed for reoccupancy.

(c) Set-Up

All interior and exterior abatement areas are to be established in largely the same manner.

The abatement Contractor shall establish a Control Area around each area where removal actions are being performed. Only properly trained personnel associated with the removal or abatement will be allowed within the Control Areas that will be established by placing barriers with signs indicating that access to the area is restricted. The Contractor's site supervisor will maintain the Control Areas and escort unauthorized personnel from the area promptly. Only those personnel actively working on the removal or abatement, will be allowed within the Regulated/Containment Area and they shall be equipped with appropriate Personal Protective Equipment (PPE).

The Contractor shall pre-clean the work areas using HEPA filtered equipment (vacuum) and/or wet methods as appropriate, collecting and properly containing all dust and debris identified as PCB Waste. Vacuum units, of suitable size and capabilities for the project, shall have HEPA filters capable of trapping and retaining at least 99.97 percent of all monodispersed particles of three micrometers in diameter or larger. Do not use methods that raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters.

After pre-cleaning, movable objects shall be removed from the work areas with the utmost care to prevent damage of any kind and relocated to a temporary storage location coordinated with the PCB Engineer. The Contractor is responsible for protecting all fixed objects that are permanent fixtures or are too large to remove and remain inside the Regulated Area. Fixed objects shall be enclosed with one layer of six (6) mil polyethylene sheeting sealed with tape.

The Contractor shall establish remote to the Regulated Area but within the Control Area, a Worker Decontamination Enclosure System consisting of Equipment Room, Shower Room and Clean Room in series.

The Shower Room shall be of sufficient capacity to accommodate the number of workers. One shower stall shall be provided for each eight (8) workers. Showers shall be equipped with hot and cold or warm running water through the use of electric hot water heaters supplied by the Contractor. No worker or other person shall leave a Regulated Area without showering. Shower water shall be collected.

The Contractor shall ensure that no personnel or equipment be permitted to leave the Control Area until proper decontamination procedures (including HEPA vacuuming, wet wiping and showering) to remove all PCB debris have occurred. No PCB-contaminated materials or persons shall enter the Clean Room.

The Contractor shall seal off all windows, doorways, skylights, ducts, grilles, diffusers, vents, light fixtures, electrical receptacles, suspended ceiling tile systems and any other openings between the Regulated Area and the uncontaminated areas outside of the Regulated Area, including the outside of the building, with critical barriers consisting of a minimum of one (1) layer of six (6) mil polyethylene sheeting securing the edges with tape. Doorways and corridors which will not be used for passage during work and separate the regulated areas from occupied areas must be sealed with fixed critical barriers constructed of 2" x 4" wood or metal framing 16" O.C., with ½" plywood on the occupied side and two layers of six (6) mil polyethylene sheeting on the Regulated Area side to prevent unauthorized access or air flow.

For exterior work areas where federally regulated and/or state regulated PCB caulks are being removed and uncontaminated building substrates are remaining (i.e. no contaminated substrate removal), a Regulated Area will be established and ground surfaces will be covered with 2 layers of 6 mil polyethylene sheeting to capture/collect any debris generated, and secured to prevent movement. The sheeting will extend a minimum of ten feet beyond the building area to be remediated and will be adhered to the building to prevent it from moving during the course of abatement. Barrier tape will be used to delineate this as the regulated area.

For exterior work areas where federally regulated and/or state regulated PCB caulks AND contaminated building substrates are being removed, a Containment Enclosure shall be constructed by the Contractor via covering of floor and wall surfaces with polyethylene sheeting sealed with tape. Polyethylene shall be applied alternately to floors and walls. Cover floors first, with a layer of six (6) mil polyethylene sheeting, so that polyethylene extends at least twelve (12) inches up on wall. Cover walls with a layer of six (6) mil polyethylene sheeting to twelve (12)

inches beyond the wall/floor intersection, thus overlapping the floor material by a minimum of twenty-four (24) inches. Repeat the process for the second layer of polyethylene. There shall be no seams at wall-to-floor joints. Contiguous to the containment, construct a single chamber airlock from six (6) mil polyethylene sheeting for entry/exit purposes into the regulated area. Where no walls exist (such as exterior work spaces) or a room is to be divided in half, the polyethelyne sheeting itself shall comprise the containment structure and shall be supported with materials which will form the containment structure and which shall maintain such integrity throughout the duration of use.

For interior work areas involving federally regulated and/or state regulated PCB caulks/glazes, a Containment Enclosure as described above shall be constructed, AND the Contractor shall also create a negative pressure differential within the containment in the range of 0.02 to 0.04 inches of water column between the Regulated Area and surrounding areas by the use of acceptable negative air pressure equipment to establish a Negative Pressure Enclosure (NPE). Exhaust air filtration units shall be equipped with HEPA filters capable of providing sufficient air exhaust to create a minimum pressure differential of 0.02 inches of water column, and to allow a sufficient flow of air through the area providing 4 air changes per hour. The Contractor shall provide a sufficient quantity of HEPA air filters to maintain the pressure differential throughout the duration of the project. An automatic warning system shall be incorporated into the equipment to indicate pressure drop or unit failure. Continuously monitor the pressure differential between the Regulated Area and surrounding area to ensure exhaust air filtration equipment maintains a minimum pressure differential of 0.02 inches of water column. The Contractor shall provide actual air flow measurement of filtration units while the unit is in place and calculate actual air exchange rates. No air movement system or air filtering equipment shall discharge unfiltered air outside the Regulated Area.

Conspicuously label and maintain emergency and fire exits from the Regulated Area satisfactory to fire officials.

The Contractor shall post warning signs to deter unauthorized personnel from entry. Additional signs may require posting following construction of workplace enclosure barriers.

(d) Personnel Protection

The Contractor shall utilize all appropriate engineering controls and safety and protective equipment while performing the work in accordance with applicable OSHA, USEPA, USDOT, CTDEEP, CTDPH regulations, and other Contract provisions.

The Contractor shall provide and require all workers to wear protective clothing in the Regulated Areas where PCB contamination exists or is likely to exist. Protective clothing shall include impervious coveralls with elastic wrists and ankles, head covering, gloves and foot coverings.

Respiratory protection shall be provided and selection shall conform to the requirements of OSHA 29 CFR 1910.134 and 42 CFR Part 84. A formal respiratory protection program must be implemented in accordance with 29 CFR 1910.134.

All other necessary personnel protective equipment (i.e. hardhat, work boots, safety glasses, hearing protection, etc.) required to perform the PCB abatement work activities shall conform to all applicable federal, state and local regulations and other applicable provisions of the Contract.

All other qualified and authorized persons by the Owner and/or Contractor entering into a Regulated Area shall be required to adhere to the requirements of personnel protection as stated in this section and all other applicable provisions of the Contract. All unqualified and unauthorized persons shall be escorted outside of the Regulated Area and if due to other provisions of the Contract, escorted outside of the project site during the PCB work.

(e) PCB Abatement Procedures

The Contractor's Site Supervisor, as the OSHA Competent Person shall be at the site at all times during the performance of abatement work.

The Contractor shall not begin abatement work until authorized by the Project Monitor, following a pre-abatement visual inspection.

The Owner shall hire a PCB Engineer for the duration of the PCB abatement work. The PCB Engineer shall provide a Project Monitor to oversee the activities of the Contractor. After removal, verification sampling and reoccupancy wipe testing shall be performed by the Project Monitor. The area shall be considered cleaned when no visible caulk/dust residue remains and any required substrate verification/reoccupancy wipe samples are <1 ppm.

All workers and authorized persons shall enter and leave the Regulated Area through the contiguous airlock, leaving contaminated protective clothing in the airlock for disposal of as PCB contaminated waste. No one shall eat, drink, smoke, chew gum or tobacco, or apply cosmetics while in a Regulated Area.

Phasing of the work areas is to be coordinated with the Construction Manager. Phase areas may be combined or divided at the direction of the PCB Engineer/CM. Proceed through the sequencing of the work phases under the direction of the Engineer/CM.

Putnam Maintenance Facility, Main Building & Cold Storage Building

Federally-regulated PCB-containing caulk and/or glazing (classified as PCB Bulk Product Waste) are defined as any building material manufactured with total PCB concentrations ≥50 ppm by weight. All Federally-regulated caulk and glazing shall be removed by the Contractor. In addition associated porous building materials in contact with the subject caulks and glazes and to be generated as demolition waste shall also be removed to a depth as specified and managed as EPA Bulk Product Waste by the Contractor.

- **Remove and dispose of caulks/glazes found to be >50ppm including:**

- **Black asphalt floor expansion joint material (EJ1) – interior cold storage builidng**

➢ **Also Remove and dispose of the following porous substrate materials found to have been impacted by the EPA Bulk Product Wastes to levels >1 ppm:**

- **Entire PCB Impacted Concrete Floor Slab Throughout Cold Storage Building**

<u>Non-federally/State regulated PCB-containing caulk and/or glazing</u> is defined as any building material manufactured with total PCB concentrations >1 ppm and < 50 ppm. All non-federally/state regulated caulk and glazing shall be removed by the Contractor.

➢ **Remove and dispose of caulks/glazes found to be >1 ppm and <50 ppm including:**

- ***Exterior light grey brittle window frame caulk (C1)* - main building – all exterior windows**
- ***Exterior tan grey pliable door caulk (C2)* - main building – bay 14, bay 18 exit door, bay 24 exit door, store room exit door**
- ***Interior window glazing (type 3) (WG3)* – main building – bays 1-5, bay 9, bay 10, bay 11, bay 12, stores, roofline above repair office & stores, repair office**

NOTES:

- *** Also asbestos containing – removal shall also proceed in accordance with Item 0020801A**
- **CT State Regulated Waste (CRW – CR01) may be disposed of in a State permitted solid waste landfill, PCB TSCA Chemical Waste Landfill, RCRA Hazardous Waste Landfill, or high temperature incinerator.**
- **Non-porous metal window/door components abutting and coated with the subject caulks shall also be removed and disposed of as CT State Regulated Waste (CRW - CR01) or the caulk/glazing will be removed to visual standards consistent with NACE Standard No.2, Near-White Blast Cleaned Surface Finish, for unrestricted use, in accordance with 40 CFR 761.79.**
- **Verification sampling of adjoining porous brick/concrete/CMU substrates associated with the State regulated caulk is <u>NOT</u> required as the Engineer has previously verified NO PCB impact above the remedial standard.**
- **Verification sampling of the porous concrete floor slab substrate associated with the EPA Bulk Product Waste (EJ1) is <u>NOT</u> required as the entire floor slab is to be removed as EPA Bulk Product PCB Impacted waste.**
- **The *PCB Bulk Product Waste Reinterpretation Memorandum* issued October 24, 2012 is being utilized for waste management and disposal.**
- **EPA PCB Bulk Product Waste (caulk, glaze and substrate) shall be disposed of in a "performance based" manner in accordance with 40 CFR 761.62(a), 62(b) and the October 24, 2012 Waste Reinterpretation Memo, and may be disposed of in a State permitted solid waste landfill, PCB TSCA Chemical Waste Landfill, RCRA Hazardous Waste Landfill, or high temperature incinerator.**

The Owner shall hire a PCB Engineer for the duration of the PCB abatement work. The PCB Engineer shall provide a Project Monitor to oversee the activities of the Contractor. After removal, verification sampling and reoccupancy wipe testing shall be performed by the Project Monitor. The area shall be considered cleaned when no visible caulk/dust residue remains and substrate verification samples are <1ppm and reoccupancy wipe samples are <10ppm.

During removal, the Contractor shall spray PCB containing building materials with water using airless spray equipment capable of providing a "mist" application to reduce airborne dust. Hose length shall be sufficient to reach all of the Regulated Area. Do not “flood” the area with hose type water supply equipment with the potential to create water releases from the regulated area.

The Contractor shall employ mechanical methods such as cutting, grinding, and pneumatic hammers to remove PCB contaminated wastes. The methods employed must not damage the integrity of the containment structure and shall not create a breach through which contaminated dust may escape. The Contractor shall be responsible for all costs associated with decontamination and remediation in the case of a containment breach.

In order to minimize PCB concentrations inside the Regulated Area, the Contractor shall remove the materials in manageable sections. In addition, PCB Waste materials removed from any elevated level shall be carefully lowered to the floor.

The Contractor shall promptly place the PCB Waste material in disposal containers (six (6) mil polyethylene bags/ poly-lined dumpsters, etc.) as it is removed. Large components removed intact may be wrapped in one (1) layer of six (6) mil polyethylene sheeting secured with tape. As the disposal containers are filled, the Contractor shall promptly seal the containers, apply caution labels and clean the containers before transportation to the airlock. Bags shall be securely sealed to prevent accidental opening and leakage by taping in gooseneck fashion. Small components and PCB Waste material with sharp-edged components (e.g. nails, screws, metal lath, tin sheeting) which could tear polyethylene bags and sheeting shall be placed in clean drums and sealed with locking ring tops. Drums may not be placed intact into final waste disposal containers intact and may be reused by the Contractor after the contents have been emptied. However, any drums use to handle wastes must be broken down and disposed of properly with other PCB wastes.

All waste containers shall be leak-tight. Containers shall be decontaminated by wet cleaning and HEPA vacuuming within the airlock prior to exiting the regulated area. Wet clean each container thoroughly before moving to a Waste Holding Area.

If at any time during PCB Waste removal, the Project Monitor should suspect contamination of areas outside the Regulated Area, the Contractor shall immediately stop all abatement work and take steps to decontaminate these areas and eliminate causes of such contamination. Unprotected individuals shall be prohibited from entering contaminated areas.

After completion of abatement work, all surfaces from which PCB Waste has been removed shall be wet brushed, using a nylon brush, wet wiped and sponged or cleaned by an equivalent method to remove all visible material. Cleaning shall also include the use of HEPA filtered vacuum equipment.

The Contractor shall also remove and containerize all visible accumulations of PCB Waste and/or PCB contaminated debris which may have splattered or collected on the polyethylene engineering controls/barriers.

The Contractor shall clean surfaces of contaminated containers and equipment thoroughly by vacuuming with HEPA filtered equipment and wet sponging or wiping before moving such items into the airlock for final cleaning and removal to uncontaminated areas.

The Contractor shall remove contamination from the exteriors of the air filtration devices, scaffolding, ladders, extension cords, hoses and other equipment inside the Regulated Area. Cleaning may be accomplished by brushing, HEPA vacuuming and/or wet cleaning. The Contractor shall wet wipe the Regulated Area beginning at the point farthest away from the negative air filtration units using cotton rags or lint free paper towels. Rags and towels shall be disposed of after each use. Workers should avoid the use of dirty rags to insure proper cleaning of surfaces. Mop the entire floor with a clean mop head and amended water. Water shall be changed frequently

Once the Regulated Area surfaces have dried, the Project Monitor shall perform a thorough post abatement visual inspection. The Project Monitor will visually inspect the Regulated Area and the surrounding Control Area to determine that the Contractor has sufficiently decontaminated and removed any dust that might contain PCBs. All surfaces within the Regulated Area, including but not limited to ledges, beams, and hidden locations shall be inspected for visible residue. Evidence of dust contamination that would be indicative of PCB contamination identified during this inspection will necessitate further cleaning as heretofore specified. The area shall be re-cleaned at the Contractor's expense, until the standard of cleaning is achieved.

Once the area has received a satisfactory post-abatement visual inspection, any equipment, tools or materials not required for completion of the work, shall be removed by the Contractor from the Regulated Area. Negative air filtration devices shall remain in place and operating for the remainder of the clean-up operation.

(f) Phased PCB Abatement Procedures

Should the potential exist for an unsafe condition to be produced by removing PCB contaminated building materials prior to removing clean materials, then the Contractor shall notify the Owner and the PCB Engineer and Project Monitor of such concerns and mitigate potentially unsafe conditions.

Should PCB contaminated building material need to remain to prevent an unsafe situation, the PCB Engineer shall collect the required verification samples prior to the performance of any

demolition in the area. The Contractor shall then physically demark the line of clean building materials as determined by the verification sampling on the structure by painting or otherwise marking the structure so that it is clearly visible.

Once the area is marked, the Contractor may remove clean building materials as described elsewhere in the Contract Document. After the clean building materials have been removed to the marked line, PCB Contaminated building materials shall be abated according to the procedures stated in section 3.12 of this specification.

(g) Post-Abatement Verification/Reoccupancy Procedures (where applicable)

Federally-Regulated PCB-Containing Materials

In work areas where federally regulated PCB caulks/glazes have been removed and no associated building materials substrate impact has been identified, such that all of the associated building material substrates are to remain in place, or all associated impacted substrates are to be removed, the remedial standard to be achieved is appropriate cleaning of the substrate such no visible caulking/glazing/paint residue remains. The Project Monitor shall perform the visual inspection to verify appropriate cleaning.

In all areas where federally-regulated PCB Wastes have been removed along with some portion of associated porous building material substrates, the remedial standard to be achieved by all verification samples of the remaining building substrate is <1 ppm total PCBs. If this standard is achieved then additional reoccupancy testing will be performed as described below. If the remedial standard is exceeded, the Contractor shall be instructed to remove additional building materials as instructed by the PCB Engineer.

Where required, the PCB Engineer shall collect verification samples as per the EPA Region 1 Standard Operating Procedure for Sampling Concrete at the frequency specified in the approved PCB Site Remedial Plan. **Verification samples shall be collected every five (5) feet around any opening left behind by the removal.** The verification samples will be analyzed for PCBs using EPA Methods 3540 and 8082. Analysis of verification samples will be expedited but the Contractor shall expect 48 to 72 hours (these hours do not include weekend and/or holiday hours) delay until analytical results are available.

In all interior work areas and exterior work areas where an enclosure was used, following completion of the visual inspections and the collection and analysis of verification samples indicating that remediation goals have been achieved, the PCB Engineer shall collect one or two reoccupancy wipe samples of horizontal surfaces within the containment area where dust would be expected to accumulate within each containment. The PCB Engineer shall obtain expedited analyses of these samples from an outside laboratory, but the Contractor shall expect 48 to 72 hours (these hours do not include weekend and/or holiday hours) delay until analytical results are available. The PCB Engineer shall instruct the Contractor to perform additional decontamination if wipe sample results are ≥10.0 µg/100 cm2. Areas which do not comply shall continue to be cleaned by and at the Contractors expense, until the specified Standard of Cleaning is achieved

as evidenced by results of wipe testing. When the Regulated Area passes the re-occupancy clearance, controls established by these Specifications may be removed.

Wipe sampling will not begin until after the area has received an acceptable post abatement visual inspection and verification sample results indicate compliance with remedial standards.

Analysis shall follow the requirements of EPA Methods 3540 and 8082.

Each homogeneous Regulated Area which does not meet the clearance criteria shall be thoroughly recleaned using HEPA vacuuming and/or wet cleaning, (with the negative pressure ventilation system in operation for interior containment areas). New samples shall be collected in the Regulated Area. The process shall be repeated until the Regulated Area passes the test, with the cost of repeat sampling being borne entirely by the Contractor.

For a PCB Waste abatement project with more than one homogeneous Regulated Area, the release criterion shall be applied independently to each Regulated Area.

Non-Federally/State Regulated PCB-Containing Materials

In work areas where Non-Federally/State Regulated PCB caulks/glazes have been removed and no associated building materials substrate impact has been identified, such that all of the associated building material substrates are to remain in place, or all associated impacted substrates are to be removed, the remedial standard to be achieved is appropriate cleaning of the substrate such no visible caulking/glazing/paint residue remains. The Project Monitor shall perform the visual inspection to verify appropriate cleaning.

In all areas where Non-Federally/State Regulated PCB Wastes have been removed along with some portion of associated porous building material substrates, or the potential impact to the porous substrate is as of yet unknown, verification sampling shall be conducted and the remedial standard to be achieved by all verification samples of the remaining building substrate is <1 ppm total PCBs. If this standard is achieved then additional reoccupancy testing will be performed as described below. If the remedial standard is exceeded, the Contractor shall be instructed to remove additional building materials as instructed by the PCB Engineer.

The PCB Engineer shall collect verification samples as per the EPA Region 1 Standard Operating Procedure for Sampling Concrete at the frequency specified in the approved PCB Site Remedial Plan. **Verification samples shall be collected every five (5) feet around any opening left behind by the removal.** The verification samples will be analyzed for PCBs using EPA Methods 3540 and 8082. Analysis of verification samples will be expedited but the Contractor shall expect 48 to 72 hours (these hours do not include weekend and/or holiday hours) delay until analytical results are available.

Each homogeneous Regulated Area which does not meet the clearance criteria shall be thoroughly recleaned using HEPA vacuuming and/or wet cleaning, (with the negative pressure ventilation system in operation for interior containment areas). The Project Monitor will then perform a final visual to verify appropriate cleaning. The process shall be repeated until the Regulated Area passes the final visual, with the cost of repeat cleaning being borne entirely by the Contractor.

For a PCB Waste abatement project with more than one homogeneous Regulated Area, the release criterion shall be applied independently to each Regulated Area.

(h) Post Abatement Work Area Deregulation

The Contractor shall remove all remaining polyethylene, including critical barriers and airlocks with the negative air filtration devices in operation. HEPA vacuum and/or wet wipe any visible residue which is uncovered during this process. All waste generated during this disassembly process shall be discarded as PCB Bulk Product Waste.

A final visual inspection of the work area shall be conducted by the Contractors Site Supervisor and the Project Monitor to ensure that all visible accumulations of PCB Waste materials have been removed and that no equipment or materials associated with the abatement work remain.

The Contractor shall restore all work areas and auxiliary areas utilized during work to conditions equal to or better than original. Any damage caused during the performance of the work activity shall be repaired by the Contractor at no additional expense to the Owner.

(i) Encapsulation Procedures (where applicable)

As applicable, the Contractor shall encapsulate building materials located in areas where renovation/demolition is not being performed as indicated (if any) on the Contract Drawings and these Specifications with an elastomeric, crack bridging, anti-carbonation, protective coating to be applied as the encapsulant.

The Contractor shall install materials in accordance with all safety and weather conditions required by manufacturer or as modified by applicable rules and regulations of local, state and federal authorities having jurisdiction. Consult Material Safety Data Sheets for complete handling recommendations.

All encapsulant materials shall be delivered in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers. Damaged material shall be removed from the site immediately. All materials shall be stored off the ground and protect from rain, freezing or excessive heat until ready for use.

The Contractor shall not apply material if it is raining or snowing or if such conditions appear to be imminent. Minimum application temperature are 45ºF (7ºC) and rising. Precautions shall be

taken by the Contractor to avoid damage to any surface near the work zone due to mixing and handling of the specified material.

The encapsulant shall be Sikagard 670W Clear, as manufactured by Sika Corporation, 1682 Marion Williamsport Road, Marion, Ohio, or equivalent. The Contractor shall provide submittals for the encapsulant to be used prior to bringing the materials onsite for use.

Elastomeric Acrylic Coating shall be one hundred percent (100%) Acrylic Emulsion with the following properties:

1. Water vapor permeable
2. Can bridge dynamically moving cracks
3. Crack bridging properties maintained at low temperatures
4. The material shall be resistant to dirt pick-up and mildew
5. Pot Life: indefinite
6. Tack Free Time 6 Hours @ 73°F, 50% Relative Humidity. Final Cure < 24 Hours
7. Carbon Dioxide Diffusion: μCO2 214,000 Carbon Dioxide Diffusion Resistance at 16 mils (400 microns)
8. SdCO2 = 299 ft. (equivalent air thickness) i.e. Approx. 9-in. of standard concrete cover.
9. Water Vapor Diffusion: μH2O 2,146 Water Vapor Diffusion Resistance at 16 mils SdH2O = 2.6 ft. (0.8m)
10. Moisture Vapor permeability (ASTM E96) 14.5 perms
11. Tensile Properties (ASTM D-412 Modified)
12. 7 day-Tensile strength 190 psi (1.3 MPa) - Elongation at break 820% - 340% @ 0°F (-18°C)
13. Crack Bridging (at 16 mils = 400 microns DFT
14. Static (at –4°F/-20°C) 30 mils (0.75mm)
15. Dynamic>1000 cycles (at –4°F/-20°C) 12 mils (0.30mm)
16. Resistance to wind driven rain (TT-C-555B): No passage of water through coating
17. Weathering (ASTM G-23) 10,000 hours excellent, no chalking or cracking.
18. Solids Content: by weight – 62% by volume – 55%
19. Flame Spread and Smoke Development (ASTM E-84-94)
20. Flame Spread 5 Smoke Development 5 Class Rating A

Note: Tests above were performed with the material and curing conditions @ 71°F – 75°F and 45-55% relative humidity.

Building substrate to which the encapsulant coating is to be applied must be clean, sound, and free of surface contaminants. Remove dust, laitance, grease, oils, curing compounds, form

release agents and all foreign particles by mechanical means. Substrate shall be in accordance with ICRI Guideline No. 03732 for coatings and fall within CSP1 to CSP3.

The Contractor shall stir materials to ensure uniformity using a low speed (400-600 rpm) drill and paddle. To minimize color variation, blend two batches of material. For small defects and cracks the Contractor shall apply Surface Filler by "Brush Grade" encapsulant generously over the center of the cracks. The Contractor shall feather material over a two-inch wide area and allow a minimum 24 hours to cure before overcoating. For large defects and cracks (cracks >20mils) the Contractor shall blow out the cut with oil-free compressed air and fill the crack with joint sealant conforming to specifications allowing for a small crest to remain as this will compensate for any shrinkage that might occur. The Contractor shall allow 24 hours-minimum cure before over coating with encapsulant.

For the final coating application, the Contractor shall apply by brush or roller over the entire area to be encapsulated by moving in one direction. The Contractor shall apply a minimum of two coats. Each coat should be applied at a rate not to exceed 100 sq. ft. per gallon. The total dry film thickness shall be minimum 8 - 10 dry mils per coat. Allow a minimum of 2 hours prior to re-coating. When applying the coating, never stop the application until the entire surface has been coated. Always stop application at an edge, corner, or joint.

(j) Waste Disposal

If the Contractor chooses to store PCB Waste onsite prior to transport offsite for disposal, the Contractor shall construct a secured Waste Storage Area at a location agreed to by the Contractor and the PCB Engineer within contract limit lines. The contract limit lines are to be secured as described elsewhere in these Specifications and entry shall be limited to Contractor Personnel only. The Waste Storage Area shall enclose all Suitable Waste Storage Containers actively in use with temporary fencing. The fence shall be marked with a Large M_L mark as specified in 40 CFR Part 761 Subpart C.

Unless otherwise specified by the Owner, all removed materials and debris resulting from execution of this work shall become the responsibility of the Contractor and removed from the premises. Materials not scheduled for reuse shall be removed from the site and disposed of in accordance with all applicable Federal, State and Local requirements.

All abatement and decontamination wastes are to be handled and stored in accordance with the provision of 40 CFR Part 761 Subpart D. The Contractor shall be responsible for all costs associated with investigation and remediation of any releases due to their failure to handle abatement wastes in accordance with the regulatory requirements

Waste removal dumpsters and cargo areas of transport vehicles shall be lined with a layer of six (6) mil polyethylene sheeting to prevent contamination from leaking or spilled containers. Floor sheeting shall be installed first, and shall be extended up sidewalls 12-inches. Wall sheeting

shall overlap floor sheeting 24-inches and shall be taped into place. A single liner may be employed as long as it entirely covers the interior of the waste container.

All containers used to transport PCB Waste for disposal must be marked with a Large M_L mark as specified in 40 CFR Part 761 Subpart C. The signs must be posted so that they are plainly visible.

Ensure all waste containers (bags, etc.) are properly packed, sealed and labeled with USEPA and USDOT shipping labels. For each shipment of PCB Waste, the Contractor shall complete a PCB waste shipment manifest.

Authorized representatives signing waste shipment records on behalf of the generator must have USDOT Shipper Certification training in accordance with HMR 49 CFR Parts 171-180.

Transport vehicles hauling PCB Waste shall have appropriate USDOT placards visible on all four (4) sides of the vehicle.

The Contractor shall dispose of federally regulated PCB Waste as performance based removal of PCB Bulk Product Waste per 40 CFR 761.62 and the *PCB Bulk Product Waste Reinterpretation Memorandum* issued October 24, 2012 at a solid waste landfill permitted under RCRA Title D or at a landfill permitted to receive such wastes (ex. RCRA hazardous landfill, facilities permitted to manage non-hazardous waste subject to 40 CFR 257.5-257.30 & a TSCA approved landfill). PCB waste (>50 ppm) shall be managed and profiled as such. Any further waste characterization sampling to satisfy contractors selected landfill shall be paid for by Contractor.

State regulated PCB Waste (>1 but <50 ppm) will be disposed of at a landfill that is permitted to receive such wastes (ex. solid waste landfill permitted under RCRA Title D, RCRA hazardous landfill & facilities permitted to manage non-hazardous waste subject to 40 CFR 257.5-257.30.) State regulated PCB waste shall be managed and profiled as such. Any further waste characterization sampling to satisfy contractors selected landfill shall be paid for by Contractor.

Any PCB Waste materials which also contain other hazardous contaminants shall be disposed of in accordance with the EPA's Resource Conservation and Recovery Act (RCRA), Toxic Substance Control Act (TSCA), and CTDEEP requirements. Materials may be required to be stored on-site and tested by the Project Monitor to determine proper waste disposal requirements.

(k) Decontamination

The Contractor shall decontaminate all moveable equipment that contacts PCB Wastes in accordance with the procedures specified in §761.79(c). The Contractor shall not remove any equipment from the Contaminant Zone until it has been properly decontaminated.

Specifically, the Contractor shall employ double wash/rinse procedures as specified in 40 CFR Part 761 Subpart S or swab non-porous surfaces that have contacted PCB wastes with a solvent as specified in §761.79(c)(2)(i). The Contractor shall segregate all liquid waste streams and be

responsible for characterizing these wastes for disposal purposes. Solid wastes generated during decontamination shall be stored for disposal with the other PCB wastes generated during remediation activities.

The PCB Engineer shall be responsible for ensuring that decontamination procedures are followed and that wastes are appropriately characterized and disposed of properly.

(l) Project Closeout Data:

Provide the Owner and PCB Engineer, within 30 days after PCB Waste has been disposed of, a compliance package; which shall include, but not be limited to, the following:

1. Site Supervisor job log;
2. Completed waste shipment records.

The Contractor shall submit the original completed waste shipment records to the PCB Engineer.

(m) Remedial Action Report

The Remedial Action Report (RAR) will be prepared upon receipt of all analytical data confirming that the removal action was complete and receipt of certifications of treatment/disposal from the treatment/disposal facility. The RAR report will be prepared by the PCB Engineer and will include the following.

1. Site description
2. A description of field procedures
3. Verification and Reoccupancy sample locations and analytical results
4. Waste characterization sample data
5. Waste transport and treatment disposal information
6. Copies of waste manifests and bills of lading

Method of Measurement:

No measurement will be made for the work in this Section. The completed work shall be paid as a lump sum.

Basis of Payment:

The lump sum bid price for PCB Building Materials Removal shall include the specialty services of the PCB Removal Contractor including: labor, materials, equipment, insurance, permits, notifications, submittals, personal air sampling, personal protection equipment, temporary enclosures, utility costs, incidentals, fees and labor incidental to the removal of PCB Wastes, including close out documentation, providing adequate containers for storage of PCB wastes until they are removed from the site and the transport and disposal of these materials at an appropriate facility. Payment for the removal and disposal of PCBs shall not be made until the Contractor submits manifests with the mass of waste disposed and signed by the receiving

facility and the Certificates of Disposal provided by the waste disposal facility for each manifested load to the Engineer. Once the manifest and Certificate of Disposal has been received, the Engineer shall make payment to the Contractor.

Pay Item	Pay Unit
PCB Building Materials Removal	Lump Sum

END OF SECTION

ITEM #0101185A – REMOVAL OF HYDRAULIC SYSTEM

Description:

Work under this item shall include all activities related to the removal and disposal of two underground twin-post hydraulic lift assemblies and the associated components (i.e., reservoir tank, piping, pumps, lift covers, steel framework, etc.), The lifts consists of one fixed-post and one traveling post. In addition, the supporting structures (i.e., piston travel pit, fixed-piston assembly vault and/or concrete thrust block) shall be removed.

The work shall be performed by an experienced firm that has successfully completed hydraulic lift removal and disposal work similar to that indicated herein.

All activities shall be performed in accordance with USEPA 40 CFR Parts 260-268, OSHA 29 CFR 1926, OSHA 29 CFR 1910.120, CTDEEP 22a-449(d)-1 and 22a-449(c), and all other applicable state and federal regulations and codes.

Materials:

Backfill material shall conform to the requirements of Section 2.13 of the Specifications or as indicated in the Contract documents.

Construction Methods:

(1) Pre-Removal Submittals:

At least fifteen (15) working days prior to the start of any lift system removal and disposal work, the Contractor shall submit the following to the Engineer for review and approval:

1. Proposed removal procedures to be utilized, including protective/safety measures to be implemented.
2. Proposed C&D bulky waste disposal facility.
3. Proposed steel/scrap metal recycling facility.

(2) General Provisions:

The Contractor shall clean (removal of hydraulic fluid, sludges and residuals), remove and dispose of the underground twin-post hydraulic lift, as indicated on the Plans.

Removal and disposal shall include the removal of all appurtenances associated with the hydraulic lifts (reservoir tank, piping and pumps, conduits, etc.). Removal shall also include disconnection of any electrical service associated with the hydraulic system and demolition of the lift's supporting structures (i.e., piston travel pit, fixed-piston assembly vault and/or concrete thrust block), the removal of residual fluids and cleaning of the post travel-pit prior to demolition.

Disposal of petroleum products and waters from within the pistons/post, travel-pit, tank and piping structures shall be performed by the Contractor in accordance *with Item No. 0101143A – Handling and Disposal of Regulated Items.*

The Contractor shall exercise all necessary precautions for fire prevention. Acceptable fire extinguishers shall be made available at all times. Flame/torch cutting is prohibited.

The Contractor shall prevent damage to any existing utilities, structures, equipment and appurtenances that are to remain in service.

(3) Removal Provisions:

Removal practices shall be acceptable to the Engineer, shall ensure the safety of persons, equipment and structures that are to remain, and shall provide adequate protection of the environment. The Contractor shall schedule excavation and removal activities to minimize delays and interference with facility operations.

The Contractor shall furnish and employ such braces, pumps, etc., as may be necessary for the protection of property, proper completion of the work, and the safety of the public and employees of the Contractor and the Department.

Excavation by machinery shall be discontinued when excavation approaches pipes, conduits or other underground structures. The work shall be completed in these areas by use of hand tools.

Following the removal of the lift, the Contractor shall excavate any impacted soil, as directed by the Engineer, to achieve compliance with Connecticut's Remediation Standard Regulations (RSRs). Soils deemed unsuitable for reuse or removed to meet regulatory requirements shall be managed in accordance with *Item No. 0101117A – Controlled Materials Handling*.

The Contractor shall assist in the collection of post-removal confirmation sampling by providing equipment and an operator to collect excavation bottom and side-wall soils. After collection of samples, the Contractor shall allow the excavation to remain open pending the receipt of laboratory analytical results by the Engineer. The Contractor shall protect on-site workers from the work area, particularly any open excavation, in a manner acceptable to the Engineer. The Contractor shall backfill the excavation immediately upon notification in writing by the Engineer. Any additional excavation beyond that necessary for hydraulic lift removal shall be as directed by the Engineer.

Excavation areas (lift removal areas, post travel-pits, piping removal areas, soil removal areas, etc.) shall be backfilled to sub-grade. If as determined by the Engineer, suitable surplus excavated materials exist, they shall be used prior to importing material to the project. Prior to placement of fill materials, areas to be filled shall be free of standing water, frost, frozen material, trash and debris.

(4) Disposal Procedures:

Scrap metal generated during the demolition process (pistons/posts, piping, etc.) shall be recycled as scrap metal at an approved scrap metal recycling facility following cleaning. Non-hazardous, non-metallic waste shall be recycled off-site or disposed of as C&D bulky waste in accordance with the Connecticut Department of Energy and Environmental Protection (CTDEEP) solid waste management standards. The Contractor shall recycle as much C&D bulky waste as practical.

Removed items shall not be reused or salvaged by the Contractor.

(5) Post-Removal Submittals:

The Contractor shall provide the Engineer, within 30 days of completion of the hydraulic lift removal work, a compliance package, which shall include, at a minimum:

1. Shipping papers and Certificates of Destruction/Recycling from the approved scrap metal recycling facility indicating receipt and acceptance of scrap metal debris (tank, piping, etc).
2. Shipping papers from the approved solid waste bulky waste disposal/recycling facility indicating receipt and acceptance of C&D bulky waste debris.

Method of Measurement:

Removal of Hydraulic System will be measured for payment by the number of hydraulic lift systems removed as shown on the Plans and directed by the Engineer.

Basis of Payment:

This work will be paid for at the Contract unit price per hydraulic lift system removed. This unit price shall include all related necessary work and material associated with the removal and disposal of the hydraulic lift assemblies and support structures, including, but not limited to: permits, equipment, material recycling and disposal, air monitoring, protection of on-site employees from the work site and temporary safety lighting. No additional payment will be made for other material or equipment necessary for the satisfactory completion of the work.

Removal and disposal of residual liquid product from the lift's hydraulic systems will be in accordance with *Item No. 0101143A – Handling and Disposal of Regulated Items*.

Pay Item	Pay Unit
Removal of Hydraulic System	Each

ITEM #0202315A - DISPOSAL OF CONTROLLED MATERIALS

Description:

Work under this Item shall consist of the loading, transportation, and final off-site treatment/ recycling/disposal of Controlled Materials that have been generated from excavation activities within the Project Limits and brought to the designated temporary storage area as surplus or unsuitable for reuse on the Project. The nature of this contaminated material is documented in the reports listed in the *Notice to Contractor – Environmental Investigations*. The Controlled Materials, after proper characterization by the Engineer, shall be taken from the temporary storage area, loaded, transported to and disposed at a permitted treatment/recycle/disposal facility listed herein.

The Contractor must use one or more of the following Department-approved treatment/ recycle/disposal facilities for the disposal of non-hazardous soils:

Advanced Disposal Services Greentree* Landfill 635 Toby Road Kersey, PA 15846 Att: Don Henrichs Phone: (814) 265-1744 Fax: (814) 265-8745	Advanced Disposal (Managed by Interstate Waste Services) 7095 Glades Pike Summerset, PA 15501 Att: Todd Casselman Phone: (814) 444-0112 Fax: (814) 444-0127
Allied Waste Niagara Fall Landfill, LLC 5600 Niagara Falls Blvd. Niagara, NY 14304 Att: David Hanson Phone: (716) 285-3344 Fax: (716) 285-3398	Clean Earth of Carteret 24 Middlesex Avenue Carteret, NJ 07008 Att: Cheryl Coffee Phone: (732) 541-8909 Fax: (732) 541-8105
Clean Earth of Connecticut 58 North Washington Street Plainville, CT 06062 Att: Scott Miller Phone: (860) 747-8888 Fax: (203) 757-4933	Clean Earth of Philadelphia 3201 S. 61 Street Philadelphia, PA 19153 Att: Mike Kelly Phone: (215) 724-5520 Fax: (215) 724-2939

Clean Earth of Southeast Pennsylvania, Inc. (AKA CESP) 7 Steel Road Morrisville, PA 19067 Att: Joe Siravo Phone: (215) 428-1700 Fax: (215) 428-1704	Clinton Landfill 242 Church Street Clinton, MA 01510 Att: Chris McGown Phone: (978) 365-4110 Fax: (978) 365-4106
Cumberland County Landfill (aka Community Refuse Services - Managed by Interstate Waste Services) 135 Vaughn Road Shippensburg, PA 17257 Att: Kevin Bush Phone: (717) 423-9953 Fax: (717) 423-9954	Colonie Landfill 1319 Louden Road Cohoes, NY 12047 Att: Eric Morales Phone: (518) 951-0794 Fax: (518) 786-7331
ESMI of New York 304 Towpath Road Fort Edward, New York 12828 Att: Peter Hanson Phone: (800) 511-3764 Fax: (518) 747-1181	Dudley Reclamation Project (W.L. French Excavating) 123 Oxford Avenue Dudley, MA Att: Jarrett Everton Phone: (978) 663-2623 Fax: (978) 663-5240
Hazelton Creek Properties, LLC* 280 South Church Street Hazelton, PA 18201 Att: Allen Swantek Phone: (870) 501-5050 Fax: (570) 457-3395	ESMI of New Hampshire 67 International Drive Loudon, NH 03307 Att: Steve Bennitt Phone: (800) 950-7645
Ontario County Landfill (Managed by Casella Waste) 3555 Post Farm Road Stanley, NY 14561 Att: Scott Sampson Phone: (603) 235-3597 Fax: (585) 526-5459	Manchester Landfill 311 Olcott Street Manchester, CT 06040 Att: Brooks Parker Phone: (860) 647-5279 Fax: (6860) 647-3238

Red Technologies Soil 232 Airline Avenue Portland, CT 06980 Att: Christopher Windangle Phone: (860) 342-1022 Fax: (860) 342-1042	Republic Services Conestoga Landfill* 420 Quarry Road Morgantown, PA 19543 Att: James Kuhn Phone: (610) 286-6844 Fax: (610) 286-7048
Soil Safe, Inc. 378 Route 130 Logan Township, Bridgeport, NJ 08085 Att: Billy Booth Phone: (410) 872-3990 Fax: (410) 872-9082	The Southbridge Recycling and Disposal Park 165 Barefoot Road Southbridge, MA 01550 Phone: (603) 235-3597 (Scott) Fax: (508) 765-6812
Ted Ondrick Company, LLC 58 Industrial Road Chicopee, MA 01020 Att: David Costanzo Phone: (413) 592-2566 Fax: (413) 592-7451	Tunnel Hill Reclamation 2500 Township Road, 205 Route 2 New Lexington, OH 43764 Att: William Gay Phone: (740) 342-1180 Fax: (914) 713-0672
Turnkey landfill - Waste Management of New Hampshire P.O. Box 7065 90 Rochester Neck Road Rochester, NH 03839 Att: Ellen Bellio Phone: (603) 330-2170 Fax: (603) 330-2130	Waste Management: RCI Fitchburg Landfill Fitchburg Princeton Road Westminster, MA 01473 Att: Frank Sepiol Phone: (978) 874-0037 Fax: (978) 355-6317

* Please note that if this facility is to be used, each bin letter will require an additional 10 days (or more) waiting period in addition to the 15-day lab period designated in the Specifications to allow for Pennsylvania Department of Environmental Protection (PADEP) review.

The above list contains treatment/recycle/disposal facilities which can accept the wastestream generated by the Project in quantities that may be limited by their permits and their operations' restrictions. It is the responsibility of the Contractor to verify that a facility will be available and capable of handling the volume as well as the chemical and physical characteristics of the material generated by the Project.

Construction Methods:

A. **Material Disposal**

The Engineer will sample materials stored at the temporary stockpile area(s) at a frequency established by the selected treatment/recycling/disposal facility. The Contractor shall designate to the Engineer which facility it intends to use, as well as the facility acceptance criteria and sampling frequency, prior to samples being collected. The Contractor is hereby notified that laboratory turnaround time is expected to be fifteen (15) working days. Turnaround time is the period of time beginning when the Contractor notifies the Engineer which facility it intends to use and that the bin within the temporary stockpile area(s) is full and ready for sampling and ending with the Contractor's receipt of the laboratory analytical results. Any change of intended treatment/recycling/disposal facility may prompt the need to resample and will therefore restart the time required for laboratory turnaround. The laboratory will furnish such results to the Engineer. Upon receipt, the Engineer will make available to the Contractor the results of the final waste characterization determinations. **No delay claim will be considered based upon the Contractor′s failure to accommodate the laboratory turnaround time as identified above.**

The Contractor shall obtain and complete all paperwork necessary to arrange for material disposal (e.g., disposal facility waste profile sheets). It is solely the Contractor's responsibility to co-ordinate the disposal of Controlled Materials with its selected treatment/recycling/disposal facility(ies). Upon receipt of the final approval from the facility, the Contractor shall arrange for the loading, transport and treatment/recycling/disposal of the materials in accordance with all applicable Federal and State regulations. **No claim will be considered based on the failure of the Contractor's selected disposal facility(ies) to meet the Contractor's production rate or for the Contractor's failure to select sufficient facilities to meet its production rate.**

Any material processing (including but not limited to the removal of woody debris, scrap metal, pressure-treated and untreated wood timber, large stone, concrete, polyethylene sheeting or similar material) required by the Contractor's selected facility will be completed by the Contractor prior to the material leaving the Site. It is solely the Contractor's responsibility to meet any such requirements of its facility. Any materials removed shall be disposed of or recycled in a manner acceptable to the Engineer at no additional cost.

All manifests or bills of lading utilized to accompany the transportation of the material shall be prepared by the Contractor and signed by an authorized Department representative, as Generator, for each truckload of material that leaves the Site. The Contractor shall forward the appropriate original copies of all manifests or bills of lading to the Engineer the same day the material leaves the Project.

A load-specific certificate of treatment/recycling/disposal, signed by the authorized agent representing the disposal facility, shall be obtained by the Contractor and promptly delivered to the Engineer for each load.

B. Material Transportation

In addition to all pertinent Federal, State and local laws or regulatory agency policies, the Contractor shall adhere to the following precautions during the transport of Controlled Materials off-site:

1. Transported Controlled Materials are to be covered sufficiently to preclude the loss of material during transport prior to leaving the Site and are to remain covered until their arrival at the selected treatment/recycling/disposal facility.

2. All vehicles departing the Site are to be properly logged to show the vehicle identification, driver's name, time of departure, destination, and approximate volume and contents of materials carried.

3. No materials shall leave the Site unless a treatment/recycling/disposal facility willing to accept all of the material being transported has agreed to accept the type and quantity of waste.

C. Equipment Decontamination

All equipment shall be provided to the work Site free of gross contamination. The Engineer may prohibit from the Site any equipment that in his opinion has not been thoroughly decontaminated prior to arrival. Any decontamination of the Contractor's equipment prior to arrival at the Site shall be at the expense of the Contractor. The Contractor is prohibited from decontaminating equipment on the Project that has not been thoroughly decontaminated prior to arrival.

The Contractor shall furnish labor, materials, tools and equipment for decontamination of all equipment and supplies that are used to handle Controlled Materials. Decontamination shall be conducted at an area designated by the Engineer and shall be required prior to equipment and supplies leaving the Project, and between different stages of the work.

The Contractor shall use dry decontamination procedures. Residuals from dry decontamination activities shall be collected and managed as Controlled Materials. If the results from dry methods are unsatisfactory to the Engineer, the Contractor shall modify decontamination procedures as required.

The Contractor shall be responsible for the collection and treatment/recycling/disposal of any liquid wastes that may be generated by its decontamination activities in accordance with applicable regulations.

Method of Measurement:

The work of "DISPOSAL OF CONTROLLED MATERIALS" will be measured for payment as the actual net weight in tons of material delivered to the treatment/recycling/disposal facility. Such determinations shall be made by measuring each hauling vehicle on the certified permanent scales

at the treatment/recycling/disposal facility. Total weight will be the summation of weight bills issued by the facility specific to this Project. Excess excavations made by the Contractor beyond the payment limits specified in Specification Sections 2.02, 2.03, 2.05, 2.06, or the Contract Special Provisions (as appropriate), will not be measured for payment and the Contractor assumes responsibility for all costs associated with the appropriate handling, management and disposal of this material.

Equipment decontamination, the collection of residuals, and the collection and disposal of liquids generated during equipment decontamination activities, will not be measured separately for payment.

Any material processing required by the Contractor-selected disposal facility, including the proper disposal of all removed materials, will not be measured for payment.

Basis of Payment:

This work will be paid for at the Contract unit price, which shall include the loading and transportation of Controlled Materials from the temporary stockpile area(s) to the treatment/recycling/disposal facility; the fees paid to the facility for treatment/recycling/disposal; the preparation of all related paperwork; and all equipment, materials, tools, and labor incidental to this work. **This unit price will be applicable to all of the listed disposal facilities and will not change for the duration of the Project.**

This price shall also include equipment decontamination; the collection of residuals generated during decontamination and placement of such material in the temporary stockpile area(s); and the collection and disposal of liquids generated during equipment decontamination activities.

Pay Item	Pay Unit
Disposal of Controlled Materials	Ton

ITEM #0202452A - TEST PIT

Description:
Work under this Item shall consist of the excavation and backfilling of test pits by the Contractor where it may be necessary to locate or examine drainage pipes, rock, public utilities, subsurface structures, or any other obstacles or conditions. Unless otherwise specified or ordered by the Engineer, the Contractor shall dig the test pit and all excavated material shall be placed back in the test pit hole and compacted in 6 inch layers. This work shall be done where directed and/or approved by the Engineer. All work shall be done in conformance with the applicable Safety Code.

Construction Methods:
The Contractor is hereby advised that underground utilities exist throughout the project work area. Test pits shall be dug where conflicts with utilities are anticipated, or as directed by the Engineer.

The Contractor shall coordinate the excavation of all test pits with the respective utility owners having facilities in the vicinity of the location of test pits. If so desired by the respective utility owners, all or part of the work under this item may be accomplished by their crews and/or supervised by them. The Contractor shall give sufficient notice to the respective utility owners to afford reasonable time for coordination.

Unless otherwise specified, the Contractor shall dig test pits where indicated by the Engineer and the Contractor shall notify the Engineer of the results at least 28 calendar days prior to the start of any underground installations within said test pit area. The Contractor shall notify the Engineer and/or utility companies of any conflict uncovered which may require design revisions, relocations and/or adjustments. No work shall be started within these areas of conflict until so authorized by the Engineer.

Test pit excavation shall have neat, clean cut and vertical sides.

The Contractor shall measure and record the size, configuration, and exact horizontal and vertical location of all utilities, pipes or other obstacles uncovered in the various pits dug under this item.

The Engineer shall be notified three (3) calendar days in advance of excavation, so that he also may make the necessary measurements to locate all objects within test pits.

Excavation of test pits shall be accomplished by such means as are required to ensure the underground utilities or structures that may be encountered are not damaged. It is the Contractor's sole responsibility for any damages incurred during excavation operations. Any such damages shall be repaired or replaced by them (if permitted) to the satisfaction of the Owner/Responsible Agency/Engineer at the Contractor's own expense. Where the repair and/or

replacement must be done by the Owner/Responsible Agency any and all costs thereof shall be borne by the Contractor.

Where existing pavement has been removed for the test pit excavation, the surface shall be restored to a condition equal or better than the original, as directed by the Engineer. When restoring the bituminous patch the tack coat shall be applied to the edges of the bituminous patch to ensure a lasting repair.

Measurement and Payment:
Test pits will be measured for payment and will be measured as each. The cutting of bituminous pavement, pavement or base removed under this item will not be measured for payment nor will the replacement pavement and subsequent replacement processed base material. Water removed will not be measured for payment.

Test pits dug by the respective utility owner will not be measured for payment.

Basis of Payment:
Payment under this item shall be made at the contract unit per each for "Test Pit", which price shall include the excavation of all materials as required. Included in the unit price will be excavation, sheeting, shoring, dewatering, backfilling, compaction and the restoration of the surface of the Test Pit, and all other materials, equipment, tools, labor and work incidental to, or necessary for the completion of the item.

Where a utility owner or company elects to perform all or part of the work under this item, no payment shall be made to either the Contractor of the participating utility for work performed by the utility under this Item, nor shall the Contract time be extended for any time lost due to poor coordination by the Contractor.

Pay Item	Pay Unit
Test Pit	EA.

ITEM #0202452A

ITEM #0202640A – 2-INCH GROUNDWATER MONITORING WELL ABANDONMENT

Description:

Work under this Item shall consist of the abandonment of 2-inch groundwater monitoring wells by a registered well driller at the locations shown on the Plans or as directed by the Engineer. Note there are fifteen 2-inch monitoring wells scheduled for abandonment at the Putnam Repair and Maintenance Facility.

Materials:

Groundwater monitoring wells shall be sealed with a grout complying with RCSA 25-128-36 (e.g., bentonite clay grout, bentonite cement grout, etc.

Construction Methods:

The well driller must be registered in the State of Connecticut in accordance with Regulations of Connecticut State Agencies (RCSA) Department of Consumer Protection (DCP) Regulations for the Well Drilling Industry, Sections 25-128-35, -58b and -60b.

The Contractor shall submit the name of the registered driller and a copy of their Certificate of Registration, as indicated in the Connecticut DCP Regulations Section 25-129, at least fourteen (14) days prior to starting well abandonment work.

Fifteen existing 2-inch monitoring wells, located within the Project Limits as depicted on the Project Plans (Drawing ENV-002), **shall be abandoned prior to the commencement of any earthwork.** The Contractor shall coordinate the work of monitoring well abandonment with the Engineer. No such work shall be performed without the Engineer present to document proper abandonment procedures.

Well Abandonment Procedure:

1. The well shall be sealed to prevent the entrance of surface water, circulation of water between or among producing zones, or any other process which could result in the contamination or pollution of groundwater resources.

2. The well shall be checked from land surface to the entire depth of the well before it is sealed to preclude any obstruction that could interfere with sealing operations.

3. The well shall be chlorinated prior to abandonment using a chlorine solution with a minimum concentration of one hundred fifty parts per million (150 ppm) of chlorine. This is equivalent to 1.1 quarts of bleach at 2.25% available chlorine to one hundred (100) gallons of water.

4. The well shall be filled and sealed with any of the following materials: neat cement grout, sand cement grout, bentonite clay grout, or bentonite cement grout.

5. The grout material shall be placed in such a way to prevent voids in the grout or dilution of the grout.

6. The well shall be abandoned in such a manner that it does not become a channel for the vertical movement of water or other substance to groundwater resources.

7. Upon completion of abandonment of the well, the existing protective road box or stick-up casing shall be removed. Surfaces shall be restored to match the existing grade. Fill material required to bring the subsurface area to grade shall conform to Article 2.13 of the Standard Specifications.

Within 30 days of completion of the well abandonment, the licensed well drilling contractor shall complete the DCP Well Abandonment "Verification of Work Completed" Form, in accordance with CGS Section 25-131, and submit such form to the DCP, CTDEEP, local Health Department and the Engineer.

Method of Measurement:

Monitoring well abandonment will be measured for payment by the number of 2-inch groundwater monitoring wells abandoned at locations shown on the Plans and directed by the Engineer.

Basis of Payment:

This work will be paid for at the Contract unit price per well abandoned. Wells that are removed as a part of excavation that are not abandoned by a registered driller (i.e., leak detection wells removed as part of the underground storage tank(s) closure activities) will not be paid for under this Item. This unit price shall include all equipment, materials and labor, including the furnishing of specialty services and specialized equipment, backfilling, excavation, disposal/recycling of removed well construction materials (e.g., road box, casing, asphalt, etc.) and implementation of health and safety provisions incidental to the abandonment of the groundwater monitoring wells.

Pay Item	Pay Unit
2-Inch Groundwater Monitoring Well Abandonment	Each

ITEM #0202642A – ABANDONMENT OF WELLS

Description:

Work under this item shall consist of the abandonment of wells by a registered well driller at locations shown on the Plans or as directed by the Engineer. The well driller must be registered in the State of Connecticut. Note there are two 6-inch product recovery wells scheduled for abandonment at the Putnam Repair and Maintenance Facility.

Well abandonment shall conform to the requirements of the Connecticut Well Drilling Code (CGS Chapter 482 Well Drilling Section 25-126 through 137) and DCP Regulations for the Well Drilling Industry, particularly Sections 128-56 and 25-128-57.

Materials:

Groundwater monitoring wells shall be sealed with a grout complying with RCSA 25-128-36 (e.g., bentonite clay grout, bentonite cement grout, etc.

Construction Methods:

The well driller must be registered in the State of Connecticut in accordance with Regulations of Connecticut State Agencies (RCSA) Department of Consumer Protection (DCP) Regulations for the Well Drilling Industry, Sections 25-128-35, -58b and -60b.

The Contractor shall submit the name of the registered driller and a copy of their Certificate of Registration, as indicated in the Connecticut DCP Regulations Section 25-129, at least fourteen (14) days prior to starting well abandonment work.

Two existing former product recovery wells, identified as R-30 and R-31(6-inch diameter wells) on Drawing ENV-002 of the Project Plans, **shall be abandoned prior to the commencement of any earthwork.** The Contractor shall coordinate the work of the well abandonment with the Engineer. No such work shall be performed without the Engineer present to verify abandonment procedures.

Abandonment procedures shall include the removal of the well sump structures (concrete) and all associated plumbing and electrical services from the ground located between the well sumps and former groundwater treatment trailer/shed.

Well Abandonment Procedure:

1. The well shall be sealed to prevent the entrance of surface water, circulation of water between or among producing zones, or any other process which could result in the contamination or pollution of groundwater resources.

2. The well shall be checked from land surface to the entire depth of the well before it is sealed to preclude any obstruction that could interfere with sealing operations.

3. The well shall be chlorinated prior to abandonment using a chlorine solution with a minimum concentration of one hundred fifty parts per million (150 ppm) of chlorine. This is equivalent to 1.1 quarts of bleach at 2.25% available chlorine to one hundred (100) gallons of water

4. The well shall be filled and sealed with any of the following materials: neat cement grout, sand cement grout, bentonite clay grout, or bentonite cement grout.

5. The grout material shall be placed in such a way to prevent voids in the grout or dilution of the grout.

6. The well shall be abandoned in such a manner that it does not become a channel for the vertical movement of water or other substance to groundwater resources.

7. Upon completion of abandonment of the well, the existing protective road box or stick-up casing shall be removed. Surfaces shall be restored to match the existing grade. Fill material required to bring the subsurface area to grade shall conform to Article 2.13 of the Standard Specifications. .

Within 30 days of completion of the well abandonment, the licensed well drilling contractor shall complete the DCP Well Abandonment "Verification of Work Completed" Form, in accordance with CGS Section 25-131, and submit such form to the DCP, CTDEEP, local Health Department and the Engineer.

Method of Measurement:

The measurement for payment under this item will be in accordance with the terms and conditions as provided in Article 1.09.04 - Extra and Cost Plus Work.

The sum of money shown on the estimate and in the itemized proposal as "Estimated Cost" for this work will be considered the price bid even though payment will be made only for actual work performed. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount bid for the Contract.

Basis of Payment:

The Abandonment of Wells will be paid for in accordance with Article 1.09.04 - Extra and Cost Plus Work, which shall include: all equipment, materials, tools and labor incidental to the well abandonment, furnishing specialty services and specialized equipment, backfilling, excavation, disposal/recycling of removed well construction materials (e.g., road box, sump structures, casing, asphalt, etc.) and implementation of health and safety provisions incidental to the abandonment of the wells.

Pay Item	Pay Unit
Abandonment of Wells	Estimated

ITEM #0204213A - HANDLING CONTAMINATED GROUNDWATER

Description:

Under this Item, the Contractor shall manage, treat and/or dispose of contaminated groundwater that may be generated during certain dewatering operations associated with Project work. Previous environmental investigations have indicated the presence of volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), extractable total petroleum hydrocarbons (ETPH) and several RCRA metals above applicable Remediation Standard Regulations groundwater criteria in the southeastern portion of the Site. Therefore, this area of the Project Limits has been designated as a Groundwater Area of Environmental Concern (GWAOEC), as depicted on Drawing ENV-003 of the Project Plans. Project work within the defined GWAOEC that requires dewatering will require handling of any resultant wastewater in accordance with this Item.

It shall be noted that this Item does not apply to the diversion of existing storm water flow around the construction site during Project activities. Diversion of existing storm water or surface flows shall be completed in accordance with the Contract and all applicable permits. Further, dewatering wastewater generated outside of the designated GWAOEC, unless otherwise indicated by the Engineer, shall not be managed under this Item but may be subject to other Project specifications and permit requirements (i.e., the *General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities* (DEEP-WPED-GP-015).

For work subject to this Item, the Contractor shall implement a system that provides for the temporary containment of contaminated groundwater generated during construction operations (i.e., free draining liquid from excavated Controlled Materials and water from dewatering activities during construction). After temporary containment, the Contractor shall treat the contaminated groundwater prior to discharge in accordance with the Connecticut Department of Energy and Environmental Protection's (CTDEEP's) *General Permit for the Discharge of Groundwater Remediation Wastewater (*DEEP-WPED-GP-027). The Department shall secure all necessary permits and authorizations from the CTDEEP and the local publicly-owned treatment works (POTW). The Contractor shall be responsible for procuring, installing, operating, cleaning, decontaminating, and dismantling the temporary groundwater management and/or treatment system, and coordinating inspections and payment of any applicable discharge fees with the POTW.

Construction Methods:

A. Submittals

The Contractor shall be responsible for procuring, installing, operating, cleaning, decontaminating, and dismantling a temporary wastewater treatment system, and coordinating inspections and payment applicable discharge fees with the local POTW.

The Contractor shall propose an economical and physically practical method of collecting, routing, treating, and discharging dewatering fluids associated with construction activities. As required for the appropriate level of operation, the Contractor shall prepare and submit to the Engineer for review a schematic of the equipment proposed for the treatment system. At a minimum, the diagram shall show all equipment, pumps, method of conveyance, pipe sizes, valve locations, sampling port locations, discharge locations, etc. This proposal shall be submitted to the Engineer for review and approval prior to commencing dewatering activities.

It is intended that the treatment system be operated from a single, fixed location throughout the duration of the Project. Power for the treatment system shall be obtained from the use of an emergency generator supplied by the Contractor, or an available power source from the Facility with approval from the Engineer.

The proposed treatment system (including all temporary containment tanks) shall be grounded in accordance with the latest edition of the National Electric Code requirements.

The treatment system shall be designed to prevent sediments and solids, as well as contaminants in excess of the permit allowable effluent concentrations, from entering the sanitary sewer system. The following list of groundwater treatment equipment should not be construed as a definitive list of items, but only an example of possible technologies and the level of detail expected for this submittal:

a. The Contractor shall install a meter to monitor the influent in order to measure the quantity of water being delivered to the treatment system. The meter shall be capable of measuring, indicating and recording instantaneous and cumulative flow. The meter shall be used continuously and shall be calibrated at the beginning of the dewatering activities, and then periodically as directed by the Engineer.

b. The Contractor shall install a meter to monitor the flow into the sanitary sewer system so that the total daily flow can be recorded for each day of the discharge. The meter shall be capable of measuring, indicating and recording instantaneous and cumulative flow. The meter shall be used continuously during discharge. The cumulative flow meter shall be non-resettable.

c. Activated carbon units, if required, shall be properly sized for the flows under given operating conditions. Each container shall contain virgin activated carbon at start-up. The units shall be supplied with a removable, gasketed cover with a bolt-type closing ring. The vessels shall have inlet and outlet couplings adequately sized for the flow and pressure rating. A drain connection shall also be provided at the bottom of the vessel. Pressure gauges shall be provided with the units so that the back-pressure of each vessel may be monitored for potential failure.

d. Settling tanks or frac tanks shall be sized to contain the total discharge from the groundwater dewatering system for a period of not less than four hours and shall be

fitted with an opening capable of accepting pumped flows from dewatering operations. The settling tank shall be able to prevent silt and other solids from entering the sanitary sewer system.

e. Particulate filters shall be bag type and be sized appropriately for the removal of particulates (silt and other solids) as required by the CTDEEP, local municipality and/or utility company.

The Contractor shall make modifications to the sanitary sewer tie-in, if necessary, to accommodate the treatment unit. The Contractor shall obtain approval from the Department, and the municipality or utility company for said modifications prior to beginning the work.

The Contractor shall design the system to accommodate the anticipated dewatering rates based on Project activities, municipality/utility limitations, and permit requirements. The Contractor is alerted that construction activities may be limited based on permit requirements or municipality/utility limitations.

2. Permits

Discharge of all collected contaminated groundwater generated by construction activities within the GWAOEC to the existing on-site sanitary sewer system shall be in accordance with the CTDEEP General Permit, and local regulations and ordinances.

The Contractor shall ensure that all personnel involved in the groundwater treatment operations understand the terms of the General Permit or authorization received from CTDEEP. In the event of a conflict between the requirements of this Item and the permit, the terms of the permit shall govern.

B. System Operation

The Contractor is responsible for operating and maintaining the treatment system while it is in operation. This includes providing appropriate supervision during evenings, weekends, and holidays if the system is operating during those periods. If the system is allowed to operate unattended, a remote alarm system meeting with the approval of the Engineer shall be installed to monitor critical system operating parameters and the Contractor shall be responsible for providing rapid emergency response during non-working hours in the event a system malfunction occurs.

The Contractor shall not commence dewatering until such time as:

a. The temporary groundwater treatment system design is reviewed and approved by the Engineer;
b. The system is installed in accordance with the accepted design and is completely operational;

c. Any necessary permit is approved by the CTDEEP, local municipality and/or utility company.

The Engineer will sample the groundwater treatment system discharge as required by the permit. The Engineer shall furnish copies of the analytical results and the Discharge Monitoring Reports to the appropriate agency(ies). The Engineer will notify the Contractor any time that the discharge exceeds the pollutant levels established in the permit. In the event of an exceedance:

1. The Contractor shall cease the discharge immediately;
2. The Engineer will notify the Department, the CTDEEP, and any other parties named in the permit; and
3. The Contractor shall modify the system to meet performance requirements.

If required, the Contractor shall restart the discharge in accordance with all necessary approvals from the CTDEEP and it shall be in full compliance with the General Permit and any amendments imposed thereto.

C. Equipment Decontamination

All equipment shall be provided to the work site free of gross contamination. The Engineer may prohibit from the Site any equipment that, in his opinion, has not been thoroughly decontaminated prior to arrival. Any decontamination of the Contractor's equipment prior to arrival at the Site shall be at the expense of the Contractor. The Contractor is prohibited from decontaminating equipment on the Project site that has not been thoroughly decontaminated prior to arrival.

The Contractor shall furnish labor, materials, tools and equipment for decontamination of all equipment and supplies that are used to handle contaminated groundwater. Decontamination shall be conducted at an area designated by the Engineer and shall be required prior to equipment and supplies leaving the Project.

The Contractor shall be responsible for the collection and disposal of any liquid wastes that may be generated by its decontamination activities in accordance with applicable regulations.

Method of Measurement

Measurement for work and materials involved with *Contaminated Groundwater Handling* will include: all equipment, materials, tools and labor incidental to collection, temporary storage, and, construction, operation, treatment, and discharge to the sanitary sewer, and any sewer discharge fees. This shall also include the final decontamination of equipment for this work.

The Engineer will sample any silt or sediments generated as a part of this Item for waste characterization determination. Disposal of the material shall be in accordance with *Item No. 0202315A - Disposal of Controlled Materials*.

Basis of Payment:

This work shall be paid for at the Contract lump sum price for "HANDLING CONTAMINATED GROUNDWATER," which shall include all materials, tools, equipment and labor incidental to the completion of this Item for the duration of the Project which shall include: construction, operation, treatment, and discharge to the sanitary sewer, payment of sewer discharge fees, and final equipment decontamination and removal.

Pay Item	Pay Unit
Handling Contaminated Groundwater	Lump Sum

ITEM #0406996A – PAVING FABRIC

Description:
Work under this item shall consist of furnishing and installing paving fabric on a bituminous concrete base course and covered with a bituminous concrete top course in the locations and to the dimensions shown on the plans as directed or as approved by the Engineer.

Submittals: Submit Product Data, including complete materials of construction and method of installation in accordance with Article 1.20-1.05.02 of Form 818. Pavement fabric manufacturer to submit certified statement of factory testing and UL certificate upon approval.

Material:
Paving Fabric: Paving fabric shall be 4.6 ounces per square yard. Provide Mirafi MPV600 by TenCate, Petromat 4597 by Propex, or equal.

Sealant: Uncut asphalt cement in conformance with fabric manufacturer's recommendations.

Construction Methods:
Install paving fabric in areas as shown on the plans. All materials shall be installed in strict accordance with the manufacturer's recommendations. A technical representative of the manufacturer shall be present at the job site for a minimum of one 8-hour workday in order to supervise the initial installation of the paving fabric.

Examine the areas and conditions under which paving fabric will be installed. Correct conditions detrimental to proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

Protect fabric from traffic during all operations. Do not allow excessive wrinkling and/or folding of the material to occur. Do not puncture or tear the fabric. Fabric damaged during construction shall be repaired in strict accordance with the manufacturer's recommendations.

Uniformly spray sealant over the surface. The rate of application shall be as recommended by the manufacturer. Apply the sealant 2 to 6 inches beyond the width of the fabric. Using a pneumatic roller, unroll fabric onto sealant. Minimize folds and wrinkles. Fabric can be cut at folds or to fit tight areas. Create joints using fabric with 1 to 3 inches overlap and approximately 0.25 gallons of sealant per square yard.

Apply bituminous top course on same day as installation of fabric. Compact as indicated on the drawings and specified herein. Turning or stopping equipment should be avoided while on the site, as this may cause tearing or displacement of the fabric.

Provide at least one person who shall be thoroughly trained and experienced in the skills required, who shall be completely familiar with the design and application of the work, and who shall be present at all times during the progress of the work, and shall direct all work performed.

Method of Measurement:
This work will be measured for Payment by the actual number of square yards of paving fabric completed, accepted and measured in place.

Basis for Payment:
This work will be paid for at the unit price per square yard for "Paving Fabric" complete in place, which shall include paving fabric, sealant, tools, material and labor incidental thereto.

There will be no direct payment made for sealant, but the cost thereof shall be included in the cost of the paving fabric item.

Pay Item	Pay Unit
Paving Fabric	S.Y.

ITEM #0406999A - ASPHALT ADJUSTMENT COST

Description: The Asphalt Adjustment Cost will be based on the variance in price for the performance-graded binder component of hot mix asphalt (HMA), Polymer Modified Asphalt (PMA), and Ultra-Thin Bonded Hot-Mix Asphalt mixtures completed and accepted during the Contract.

The Asphalt Price is available on the Department of Transportation website at:

http://www.ct.gov/dot/asphaltadjustment

Construction Methods:

An asphalt adjustment will be applied only if all of the following conditions are met:

I. For HMA and PMA mixtures:
   a. The HMA or PMA mixture for which the adjustment would be applied is listed as a Contract item with a pay unit of tons.
   b. ***The total quantity for all HMA and PMA mixtures in the Contract or individual purchase order (Department of Administrative Service contract awards) exceeds 1000 tons or the Project duration is greater than 6 months.***
   c. The difference between the posted *Asphalt Base Price* and *Asphalt Period Price* varies by more than $5.00 per ton.

II. For Ultra-Thin Bonded HMA mixtures:
   a. The Ultra-Thin Bonded HMA mixture for which the adjustment would be applied is listed as a Contract item.
   b. The total quantity for Ultra-Thin Bonded HMA mixture in the Contract exceeds:
      i. 800 tons if the Ultra-Thin Bonded HMA item has a pay unit of tons.
      ii. 30,000 square yards if the Ultra-Thin Bonded HMA item has a pay unit of square yards.

      Note: The quantity of Ultra-Thin Bonded HMA measured in tons shall be determined from the material documentation requirements set forth in the Ultra-Thin Bonded HMA item Special Provision.
   c. The difference between the posted *Asphalt Base Price* and *Asphalt Period Price* varies by more than $5.00 per ton.
   d. No Asphalt Adjustment Cost will be applied to the liquid emulsion that is specified as part of the Ultra-Thin Bonded HMA mixture system.

III. Regardless of the binder used in all HMA or PMA mixtures, the Asphalt Adjustment Cost will be based on PG 64-22.

The Connecticut Department of Transportation (CTDOT) will post on its website, the average per ton selling price (asphalt price) of the performance-graded binder. The average is based on the high and low selling price published in the most recent available issue of the **Asphalt Weekly Monitor®** furnished by Poten & Partners, Inc. under the "East Coast Market – New England, New Haven, Connecticut area," F.O.B. manufacturer's terminal.

The selling price furnished from the Asphalt Weekly Monitor ® is based on United States dollars per standard ton (US$/ST).

Method of Measurement:

Formula: **HMA x [PG%/100] x [(*Period Price - Base Price*)] = $ ____**

where

- **HMA:**
  1. For HMA, PMA, and Ultra-Thin Bonded HMA mixtures with pay units of tons: The quantity in tons of accepted HMA, PMA, or Ultra-Thin Bonded HMA mixture measured and accepted for payment.
  2. For Ultra-Thin Bonded HMA mixtures with pay units of square yards: The quantity of Ultra-Thin Bonded HMA mixture delivered, placed, and accepted for payment, calculated in tons as documented according to the Material Documentation provision (Construction Methods, paragraph G) of the Ultra-Thin Bonded HMA Special Provision.
- ***Asphalt Base Price***: The asphalt price posted on the CTDOT website 28 days before the actual bid opening posted.
- ***Asphalt Period Price***: The asphalt price posted on the CTDOT website during the period the HMA or PMA mixture was placed.
- **PG%:** Performance-Graded Binder percentage
  1. For HMA or PMA mixes:
     - PG% = 4.5 for HMA S1 and PMA S1
     - PG% = 5.0 for HMA S0.5 and PMA S0.5
     - PG% = 6.0 for HMA S0.375, PMA S0.375, HMA S0.25 and PMA S0.25
  2. For Ultra-Thin Bonded HMA mixes: PG% = Design % PGB (Performance Graded Binder) in the approved job mix formula, expressed as a percentage to the tenth place (e.g. 5.1%)

The asphalt adjustment cost shall not be considered as a changed condition in the Contract as result of this provision since all bidders are notified before submission of bids.

Basis of Payment: The "Asphalt Adjustment Cost" will be calculated using the formula indicated above. A payment will be made for an increase in costs. A deduction from monies due the Contractor will be made for a decrease in costs.

The sum of money shown on the Estimate and in the itemized proposal as "Estimated Cost" for this item will be considered the bid price although the adjustment will be made as described above. The estimated cost figure is not to be altered in any manner by the bidder. If the bidder should alter the amount shown, the altered figure will be disregarded and the original cost figure will be used to determine the amount of the bid for the Contract.

Pay Item	Pay Unit
Asphalt Adjustment Cost	est.

ITEM #0969054A - CONTRACTOR QUALITY CONTROL PROGRAM LEVEL 1

Description: The Contractor shall establish, maintain, and implement a written Project-specific Quality Control (QC) Program tailored to the complexity and scope of the work. This Program shall detail the programmatic documentation of the Contractor's processes for delivering the level of construction quality required by the Contract.

The written QC Program shall provide a comprehensive description of the planning, monitoring and reporting program the Contractor shall implement to ensure and document the quality of the work as it progresses.

The QC Program shall address, as a minimum, the following elements: Organization; Design Control; Procurement Control; Control of Subcontractors, Fabricators and Suppliers; Inspection; Special Process Control; Non-Conformance Resolution; Records; and Reporting.

The QC Program shall identify and list critical and routine work categories, which shall be used to differentiate the level of reporting, inspection and attention throughout the process.

The QC Program shall include a method to identify and resolve any deviations from the Contract while maintaining the Project schedule. The QC Program shall include a method to prevent recurring deviations once identified and resolved.

The Contractor shall modify the QC Program as needed to meet the requirements of this specification. The QC Program shall be recognized as a dynamic document, subject to revisions and amendments, as required, in response to actual Site conditions, work methods, and to address deviations encountered and corrected throughout the Project.

The Contractor shall furnish the services of a dedicated (sole responsibility), full-time, on-Site Quality Control Manager (QCM) for the Project. The QCM shall report directly to upper management and shall have the authority to issue stop work orders.

When the Contractor's schedule dictates simultaneous work operations, the Contractor is responsible for supplementing the QCM with additional QC personnel (independent of trade staff) to meet the requirements of this specification.

The additional Contractor Quality Control requirements described herein shall be used in conjunction with the Department's Standard Specifications. The QC Program is neither intended to relieve the Contractor from its responsibility under the Contract, nor to replace the external inspections of the work carried out by the Engineer.

The minimum lump sum bid for this item shall be **$240, 000.00**. Failure of the Contractor to bid at least the minimum amount will result in the Department adjusting the Contractor's bid to the minimum bid amount for this item.

Construction Methods:

Submittals

(1) QCM: Within thirty (30) days of Contract award, the Contractor shall submit, in writing, the name of their proposed QCM with a resume of their qualifications, submitted in accordance with the requirements listed below, for concurrence by the Department. The QCM shall not be changed without prior written notification to the Department.

The submittal shall outline the credentials of the proposed QCM, who shall be an individual with demonstrated construction experience. This shall include at least 7 years of experience in any combination of the following areas:

- Field inspection experience
- Construction experience relevant to the type of work and the scope of the Project
- Previous experience as a Quality Control professional

The submittal shall also list any certifications or training in quality control principles (NETTCP Quality Assurance Technologist or approved equal) of the proposed QCM and two (2) letters of recommendation from previous clients.

(2) QC Program: Within forty-five (45) days of Contract award, the Contractor, with direct input from the QCM, shall prepare and submit to the Department, for review and approval, a written QC Program, including the Elements listed below, and in accordance with all requirements of this specification.

Sample forms and reports intended to be used to assure compliance with this specification shall be included in the initial submittal of the QC Program. Sample forms and reports shall include:

- Sample document control tracking form
- Sample design control tracking form (for Contractor design-build items)
- Sample Shop Drawing/Working Drawing review
- Sample material receiving inspection report
- Sample inspection forms for critical work categories
- Sample special process control forms
- Sample non-conformance report
- Sample daily and monthly reports

The Contractor's QCM, Project Manager and a representative of their upper management shall sign the final QC Program submission and any revisions or amendments thereto. Any revisions or amendments made to the QC Program shall be submitted in writing to the Engineer for acceptance.

Subcontractors, fabricators and suppliers involved in critical work categories, as defined in the QC Program, shall have their own work-item specific QC Plan which shall be included as an addendum to the Contractor's QC Program, and shall comply with all conditions of this item.

(3) Additional QC Personnel: When additional QC personnel are required due to simultaneous work operations, the Contractor shall provide resume(s) of qualifications of the proposed personnel at least thirty (30) days in advance of the work. All additional QC personnel utilized for inspecting, sampling, and testing of materials shall be certified by NETTCP (or another entity acceptable to the Department) in the appropriate designation for the work or materials being inspected, sampled, or tested. These individual(s) shall also have demonstrated construction experience of at least 5 years in any combination of the following areas:

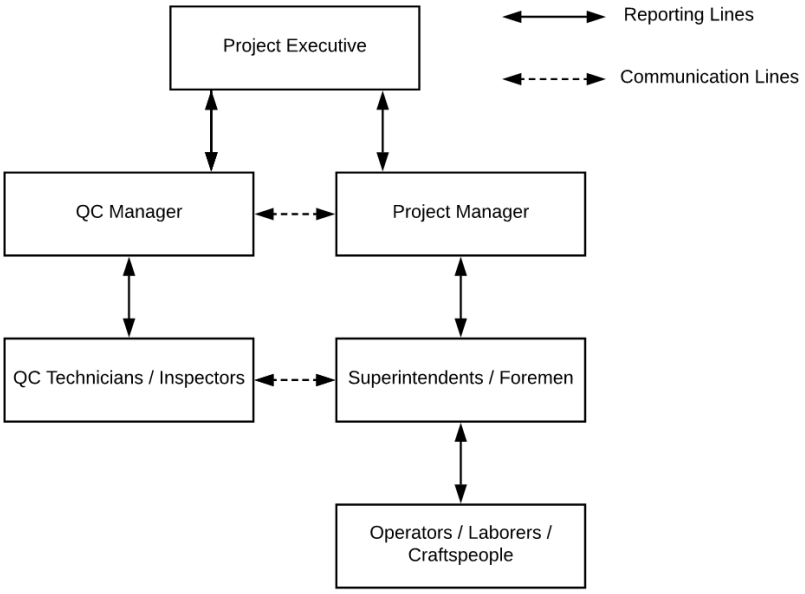
- Field inspection experience
- Construction experience relevant to the type of work and the scope of the Project
- Previous experience as a Quality Control professional

(4) Laboratories: All laboratories performing QC testing of Project Produced Materials shall be qualified through either the AASHTO Accreditation Program (AAP) or the NETTCP Laboratory Qualification Program. The Contractor shall provide laboratory proof of qualification at least thirty (30) days in advance of the work.

(5) Reports: The Contractor shall be required to produce and submit to the Engineer daily and monthly inspection reports as described in the Reporting Element of this specification.

Elements of the Contractor Quality Control Program:

1. Organization: This Element shall describe the Contractor's organization, including reporting relationships within and external to the Contractor's organization. The name of the QCM shall be clearly stated and this individual shall be responsible to upper management and have the authority to stop work. An organizational chart shall be included to graphically depict the Contractor's organizational structure and major reporting lines and relationships. The organizational chart shall clearly show the hierarchy between the QCM, upper management and additional QC personnel; and a narrative shall follow which shall define the roles, duties and responsibilities of each person in the implementation of the QC Program and in the resolution of QC issues. This Element shall also include the resumes of all QC personnel.



2. Design Control: This Element shall describe how the Contractor and the QCM control any design process (i.e. Working and Shop Drawings) for which it is responsible. This shall include the selection of design input data, checking for correctness, completeness, compatibility and format, and reviewing and approving design output documents prior to submission to the Department. This Element shall provide guidance as to how the QCM or other personnel shall indicate that documents have been reviewed by the Contractor prior to submission, and that Department comments have been adequately addressed prior to any required resubmissions.

3. Procurement Control: This Element shall describe the methods used by the Contractor and the QCM to assure that all materials and specialized equipment provided for the work are as specified. Included shall be guidelines for documenting that purchase documents have been reviewed to assure that correct details have been ordered, including specification, grade, type, color, Buy America or other aspects as required by the Contract.

This Element shall describe receiving inspection activities to be performed, and documentation required to confirm that the correct material or equipment has been delivered. A list of items requiring Materials Certificates and/or Certified Test Reports shall be developed by the Contractor and included in this Element. The Contractor shall prepare a "Material Receiving

Inspection Report" which shall include records of inspections performed and reviews of material test reports or other documentation required by the Contract. It shall also include copies of Materials Certificates and/or Certified Test Reports for all these items.

As a minimum, receiving inspections shall be performed on the following materials:

- Materials requiring a Materials Certificate or Certified Test Report
- Source-Controlled Materials (not inspected at the manufacturing plant)
- Job-Controlled Materials (other than concrete, bituminous and soils)

Following a receiving inspection, a copy of the "Material Receiving Inspection Report," along with associated documents, shall be submitted to the Engineer.

4. Control of Subcontractors, Fabricators and Suppliers: Subcontractors, fabricators and suppliers involved in critical work categories, as defined in 5(a) herein, shall develop their own QC Plan to be added as an addendum to the Contractor's QC Program, which shall comply with all conditions of this item. The Contractor shall be responsible for reporting on QC activities performed by or for subcontractors, fabricators and suppliers.

It is the Contractor's responsibility to notify all subcontractors, fabricators, and suppliers of the requirements of the Contract. This Element shall describe the methods used by the Contractor and the QCM to assure that all the applicable requirements of the Contract are passed on to the subcontractors, fabricators and suppliers. This Element shall include the methods used by the Contractor and the QCM to monitor and control the quality of the work performed by subcontractors, fabricators and suppliers, and to obtain the required quality records.

This Element shall also describe how the Contractor will ensure that:

- The Engineer receives advance notice of:
  - The source of supply
  - The location of fabrication, including component parts
  - The schedule of fabrication, including the date of beginning of fabrication and the date the material is to be delivered to the Project
- Material fabricated specifically for the Project will be inspected and approved prior to being shipped or incorporated into the work
- Properly documented mill test reports are furnished by suppliers
- Subcontractors are approved prior to performing any work for or on the Project
- Consider adding additional bullets at QC FDP Meeting

5. Inspection: This Element shall describe how the Contractor and the QCM will assure that the specified quality of materials and workmanship will be achieved. The Contractor's QC Program is not related to any inspection carried out by the Engineer. Inspection will include the identification and tracking of the quality characteristics (metrics) used to verify that the level of quality of materials and workmanship conforms to the requirements of the Contract.

The QC Program shall identify the reporting requirements for each item based on its work category, and these reporting requirements will be approved by the Engineer. The work categories will be identified as **critical** or **routine**.

(a) Critical Work Categories: For this Project, critical work categories shall include, but are not limited to the following:

- Construction Surveying
- Maintenance & Protection of Traffic
- Earthwork

- Subbase and Base Material
- Hot Mix Asphalt
- Drainage
- Reinforcing Steel
- Structural Steel
- Structural Concrete
- Electrical
- Landscaping
- Environmental Compliance
- Permit Compliance

The QCM shall be familiar with all aspects of work related to critical work categories and no work shall be performed on these categories without the prior knowledge of the QCM. The QC Program shall define specific means and methods that shall be employed to minimize, identify, resolve and prevent recurrence of deviations from the Contract in regards to materials or workmanship for each of the critical work categories listed.

The QC Program shall identify hold points in the critical work categories beyond which work operations cannot proceed until the QCM and the Engineer have inspected the work in place and releases the hold.

When simultaneous critical work categories are required by the Contractor's schedule, additional QC personnel shall be required.

This Element shall describe the system(s) used to assure that all materials and workmanship for critical work categories are in conformance with the Contract, including:

- visual inspection of the work, including frequency and hold points
- materials to be tested
- tests to be conducted
- frequency of testing
- locations of sampling
- checks
- intermittent or continuous inspections
- inspections of completed work
- or a combination of above methods

Quality control reporting forms shall be developed to document the work performed by the QCM and QC personnel, on each of these critical work categories. The forms shall be signed by Contractor supervisory field personnel, the QCM and QC personnel (if applicable), to document conformance of the work being performed. All work performed by the QCM and QC personnel on these critical work categories shall be documented and included in the QCM's daily and monthly reports.

(b) Routine Work Categories: All other work categories not covered by 6(a) will be defined as routine work categories and the general provisions of this specification shall apply.

6. Special Process Control: This Element shall describe the measures to be used to assure that any special processes (such as, welding, high-strength bolting, nondestructive examination, critical coatings, surveys, and control of critical tolerances) shall be controlled by procedures that are described in and comply with the Contractor's approved QC Program. The recording of

results shall properly document that processes are in conformance with the Contract. In addition, this Element shall describe the methods used to verify, document and track any pre-qualification of the processes, personnel and equipment where required by the Contract.

7. **Non-Conformance Resolution:** This Element shall describe the protocol(s) for correcting any material or workmanship found not to be in compliance with the Contract, the reporting requirements for documenting any non-compliance, subsequent corrective measures and issue resolution.

   (a) Contractor-Issued Non-Conformance Reports: This Element shall outline the Contractor's use of self-issued non-conformance reports to document actions taken to identify, resolve and prevent recurring deviations. The non-conformance reports shall include signatures of the responsible persons for each process of the corrective action taken. Upon resolution of a non-conformance issue, the QC Program shall be revised to identify preventive measures that shall be taken to prevent similar deviations. Contractor supervisory field personnel involved in the work shall be informed of any changes implemented to avoid recurrence of deviations.

   (b) Engineer-Issued Non-Compliance Notices (NCN): Non-compliance notices (NCNs) issued by the Engineer shall also be an indication of non-conformance and shall be addressed according to 1.05.11 and resolved to the satisfaction of the Engineer. Upon resolution, the QC Program shall be revised to identify preventive measures that shall be taken to prevent similar deviations. Contractor supervisory field personnel involved in the work shall be informed of any changes implemented to avoid recurrence of deviations.

8. **Records:** This Element shall describe how various records generated by the Contractor are originated, maintained, received, filed, protected and authenticated. Quality Control records required for submittal to the Engineer shall be described. This Element shall outline the Contractor's procedure for retaining records for a period of 3 years after acceptance of the Contract.

9. **Reporting:** <u>QC Inspection Reports:</u> The Contractor shall be required to produce and submit to the Engineer daily and monthly inspection reports in accordance with all requirements of this specification. The QC Program shall clearly define the information that shall be provided as part of the daily and monthly reports.

   (a) Daily Reports: Daily reports shall include documentation of all activities, including inspection, material testing, and any work associated with the Elements of this specification, performed by the QCM and other QC personnel. The location of any forms relative to this specification shall be referenced in the daily reports.

   For any week that a non-conformance report is issued, either by the Contractor or the Engineer, actions taken to resolve the non-conformance report shall be summarized and included with the submission of the daily reports. Updates on the status of the non-conformance shall continue in each submission of daily reports until the non-conformance issue is resolved. Once resolved, the next submission of daily reports shall document that supervisory field personnel involved in the work have been informed of any changes to be implemented to avoid recurrence of deviations. Any revisions or amendments made to the QC Program, once submitted and accepted by the Engineer, shall be documented in the next submission of daily reports.

Daily reports shall be submitted (as a package) to the Engineer by 12 PM on the Tuesday following the week of the inspection reports, or as agreed to by the Engineer. Except as otherwise authorized by the Engineer, submissions after that time will be considered late.

(b) Monthly Reports: Monthly reports shall include a summary of the work performed, including QC activities, in the previous month and also a one (1) month "look ahead" schedule with expected QC efforts and procedures for critical and routine work categories. Monthly reports shall also include a submittal status update spreadsheet.

Monthly reports shall be submitted to the Engineer by the fifth (5th) business day each month. Except as otherwise authorized by the Engineer, monthly submissions after that time will be considered late.

(c) Quality Assurance/Quality Control (QA/QC) Meetings: Meetings shall be held specific to the QC Program. The Contractor shall, at minimum, be represented by the QCM and shall meet with the Engineer every other week, or more frequently at the Engineer's request, to review reporting and all work related to this specification.

Method of Measurement: Within forty-five (45) calendar days of the award of the Contract, the Contractor shall submit to the Engineer for approval a schedule of values of its lump sum bid price for this item detailing the following:

1. The development costs to prepare the written QC Program. Development costs shall be ten percent (10%) of the total cost of the item.
2. The cost per-month to provide the services of the QC Program, including the QCM, QC activities, necessary QC personnel, preparing and submitting daily and monthly reports, and all other requirements of this specification. A per-month cost will be derived by taking the lump sum bid price, subtracting the development cost to prepare the written QC Program, and dividing the remainder by the number of Contract months remaining from the date of submission of the written QC Program.

Basis of Payment: This item will be paid for at the Contract lump sum price for "Contractor Quality Control Program Level 1" complete, which price shall include all submittals, QC Program revisions and amendments, inspections, monitoring, daily logs, reports, meetings, records, and all materials, equipment, labor and work incidental thereto.

Upon approval of the schedule of values by the Engineer, payments for work performed will be made as follows:

1. Upon acceptance of the written QC Program, the lump sum development cost from the payment schedule will be approved for payment.
2. Upon acceptable completion of the services of the QC Program for the month, the per-month cost will be approved for payment.

The Engineer reserves the right to apply the following reductions to the monthly payment portion, which cannot be recovered and will result in a reduction in the lump sum amount, should the Contractor fail to meet the requirements of this specification:

1. QC staff: A five percent (5%) reduction to the monthly payment will be applied for each day that acceptable QC services are not provided. The total reduction for any calendar month will not exceed the monthly payment for the item.
2. Reports: A five percent (5%) reduction to the monthly payment will be applied for each day that the required reports have been submitted late, up to a maximum of fifty percent

(50%) of the monthly payment per report. This five percent (5%) reduction will apply to each independent report (each package of daily reports, described in 9(a) above, submitted on a weekly basis is considered one independent report). The total reduction for any calendar month will not exceed the monthly payment for the item.

3. QA/QC Meetings: A twenty-five percent (25%) reduction to the monthly payment will be applied for each bi-weekly QA/QC meeting not attended by the QCM. The total reduction for any calendar month will not exceed the monthly payment for the item.

Should the Contractor fail to continuously provide an acceptable QC Program, as required by this specification, the Engineer may withhold the entire monthly estimate until such time as all requirements are met.

Should the Contractor fail to comply with the QCM requirements of this specification, the QCM shall be replaced at the Engineer's request.

Only one monthly payment will be made for each calendar month regardless of the number of personnel required to complete the specified work.

Pay Item	Pay Unit
Contractor Quality Control Program Level 1	l.s.

ITEM #0969064A - CONSTRUCTION FIELD OFFICE, LARGE

Description: Under the item included in the bid document, adequate weatherproof office quarters with related furnishings, materials, equipment and other services, shall be provided by the Contractor for the duration of the work, and if necessary, for a close-out period determined by the Engineer. The office, furnishings, materials, equipment, and services are for the exclusive use of CTDOT forces and others who may be engaged to augment CTDOT forces with relation to the Contract. The office quarters shall be located convenient to the work site and installed in accordance with Article 1.08.02. This office shall be separated from any office occupied by the Contractor. Ownership and liability of the office quarters shall remain with the Contractor.

Furnishings/Materials/Supplies/Equipment: All furnishings, materials, equipment and supplies shall be in like new condition for the purpose intended and require approval of the Engineer.

Office Requirements: The Contractor shall furnish the office quarters and equipment as described below:

Description \ Office Size	Small	Med.	Large	Extra Large
Minimum Sq. Ft. of floor space with a minimum ceiling height of 7 ft.	400	400	1000	2000
Minimum number of exterior entrances.	2	2	2	2
Minimum number of parking spaces.	7	7	10	15

Office Layout: The office shall have a minimum square footage as indicated in the table above, and shall be partitioned as shown on the building floor plan as provided by the Engineer.

Tie-downs and Skirting: Modular offices shall be tied-down and fully skirted to ground level.

Lavatory Facilities: For field offices sizes Small and Medium the Contractor shall furnish a toilet facility at a location convenient to the field office for use by CTDOT personnel and such assistants as they may engage; and for field offices sizes Large and Extra Large the Contractor shall furnish two (2) separate lavatories with toilet (men and women), in separately enclosed rooms that are properly ventilated and comply with applicable sanitary codes. Each lavatory shall have hot and cold running water and flush-type toilets. For all facilities the Contractor shall supply lavatory and sanitary supplies as required.

Windows and Entrances: The windows shall be of a type that will open and close conveniently, shall be sufficient in number and size to provide adequate light and ventilation, and shall be fitted with locking devices, blinds and screens. The entrances shall be secure, screened, and fitted with a lock for which four keys shall be furnished. All keys to the construction field office shall be furnished to the CTDOT and will be kept in their possession while State personnel are using the office. Any access to the entrance ways shall meet applicable building codes, with appropriate handrails. Stairways shall be ADA/ABA compliant and have non-skid tread surfaces. An ADA/ABA compliant ramp with non-skid surface shall be provided with the Extra-Large field office.

Lighting: The Contractor shall equip the office interior with electric lighting that provides a minimum illumination level of 100 foot-candles at desk level height, and electric outlets for each desk and drafting table. The Contractor shall also provide exterior lighting that provides a minimum illumination level of 2 foot-candles throughout the parking area and for a minimum distance of 10 ft. on each side of the field office.

Parking Facility: The Contractor shall provide a parking area, adjacent to the field office, of sufficient size to accommodate the number of vehicles indicated in the table above. If a paved parking area is not readily available, the Contractor shall construct a parking area and driveway consisting of a minimum of 6 inches of processed aggregate base graded to drain. The base material will be extended to the office entrance.

Field Office Security: Physical Barrier Devices - This shall consist of physical means to prevent entry, such as: 1) All windows shall be barred or security screens installed; 2) All field office doors shall be equipped with dead bolt locks and regular day operated door locks; and 3) Other devices as directed by the Engineer to suit existing conditions.

Electric Service: The field office shall be equipped with an electric service panel, wiring, outlets, etc., to serve the electrical requirements of the field office, including: lighting, general outlets, computer outlets, calculators etc., and meet the following minimum specifications:

A. 120/240 volt, 1 phase, 3 wire
B. Ampacity necessary to serve all equipment. Service shall be a minimum 100 amp dedicated to the construction field office.
C. The electrical panel shall include a main circuit breaker and branch circuit breakers of the size and quantity required.
D. Additional 120 volt, single phase, 20 amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed at each desk and personal computer table (workstation) location.
E. Additional 120 volt, single phase, 20 amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed, for use by the Telephone Company.
F. Additional 120-volt circuits and duplex outlets as required meeting National Electric Code requirements.
G. One exterior (outside) wall mounted GFI receptacle, duplex, isolated ground, 120 volt, straight blade.
H. After work is complete and prior to energizing, the State's CTDOT electrical inspector, must be contacted at 860-594-2240. (Do Not Call Local Town Officials)
I. Prior to field office removal, the CTDOT Office of Information Systems (CTDOT OIS) must be notified to deactivate the communications equipment.

Heating, Ventilation and Air Conditioning (HVAC): The field office shall be equipped with sufficient heating, air conditioning and ventilation equipment to maintain a temperature range of 68º-80º Fahrenheit within the field office.

Telephone Service: The Contractor shall provide telephone service with unlimited nation-wide calling plan. For a Small, Medium and Large field office this shall consist of the installation of two (2) telephone lines: one (1) line for phone/voice service and one (1) line dedicated for the facsimile machine. For an Extra-Large field office this shall consist of four (4) telephone lines: three (3) lines for phone/voice service and one (1) line dedicated for facsimile machine. The Contractor shall pay all charges.

Data Communications Facility Wiring: Contractor shall install a Category 6 568B patch panel in a central wiring location and Cat 6 cable from the patch panel to each PC station, Smart Board location, Multifunction Laser Printer/Copier/Scanner/Fax, terminating in a (Category 6 568B) wall or surface mount data jack. The central wiring location shall also house either the data circuit with appropriate power requirements or a category 5 cable run to the location of the installed data circuit. The central wiring location will be determined by the CTDOT OIS staff in coordination with the designated field office personnel as soon as the facility is in place.

For Small, Medium and Large field offices the Contractor shall run a CAT 6 LAN cable a minimum length of 25 feet for each CTDOT networked device (including but not limited to: smartboards and Multi-Function Laser Printer/Copier/Scanner/Fax) to LAN switch area leaving an additional 10 feet of cable length on each side with terminated RJ45 connectors. For an Extra-Large field office the Contractor shall run CAT 6 LAN cables from workstations, install patch panel in data circuit demark area and terminate runs with RJ45 jacks at each device location. Terminate runs to patch panel in LAN switch area. Each run / jack shall be clearly labeled with an identifying Jack Number.

The Contractor shall supply cables to connect the Wi-Fi printer to the Contractor supplied internet router and to workstations/devices as needed. These cables shall be separate from the LAN cables and data Jacks detailed above for the CTDOT network.

The number of networked devices anticipated shall be at least equal to the number of personal computer tables, Multi-Function Laser Printer/Copier/Scanner/Fax, and smartboards listed below.

The installation of a data communication circuit between the field office and the CTDOT OIS in Newington will be coordinated between the CTDOT District staff, CTDOT OIS staff and the local utility company once the Contractor supplies the field office phone numbers and anticipated installation date. The Contractor shall provide the field office telephone number(s) to the CTDOT Project Engineer within 10 calendar days after the signing of the Contract as required by Article 1.08.02. This is required to facilitate data line and computer installations.

Additional Equipment, Facilities and Services: The Contractor shall provide at the field Office at least the following to the satisfaction of the Engineer:

Furnishing Description	Office Size			
	Small	Med.	Large	Extra Large
	Quantity			
Office desk (2.5 ft. x 5 ft.) with drawers, locks, and matching desk chair that have pneumatic seat height adjustment and dual wheel casters on the base.	1	3	5	8
Standard secretarial type desk and matching desk chair that has pneumatic seat height adjustment and dual wheel casters on the base.	-	-	-	1
Personal computer tables (4 ft. x 2.5 ft.).	2	3	5	8
Drafting type tables (3 ft. x 6 ft.) and supported by wall brackets and legs; and matching drafters stool that have pneumatic seat height adjustment, seat back and dual wheel casters on the base.	1	1	1	2
Conference table, 3 ft. x 12 ft.	-	-	-	1
Table – 3 ft. x 6 ft.	-	-	-	1
Office Chairs.	2	4	8	20
Mail slot bin – legal size.	-	-	1	1
Non-fire resistant cabinet.	-	-	2	4
Fire resistant cabinet (legal size/4 drawer), locking.	1	1	2	3
Storage racks to hold 3 ft. x 5 ft. display charts.	-	-	1	2
Vertical plan racks for 2 sets of 2 ft. x 3 ft. plans for each rack.	1	1	2	2
Double door supply cabinet with 4 shelves and a lock – 6 ft. x 4 ft.	-	-	1	2
Case of cardboard banker boxes (Min 10 boxes/case)	1	1	2	3
Open bookcase – 3 shelves – 3 ft. long.	-	-	2	2
White Dry-Erase Board, 36” x 48”min. with markers and eraser.	1	1	1	1
Interior partitions – 6 ft. x 6 ft., soundproof type, portable and freestanding.	-	-	6	6
Coat rack with 20 coat capacity.	-	-	-	1
Wastebaskets - 30 gal., including plastic waste bags.	1	1	1	2
Wastebaskets - 5 gal., including plastic waste bags.	1	3	6	10
Electric wall clock.	-	-	-	2
Telephone.	1	1	1	-
Full size stapler 20 (sheet capacity, with staples)	1	2	5	8
Desktop tape dispensers (with Tape)	1	2	5	8
8 Outlet Power Strip with Surge Protection	3	4	6	9
Rain Gauge	1	1	1	1
Business telephone system for three lines with ten handsets, intercom capability, and one speaker phone for conference table.	-	-	-	1
Mini refrigerator - 3.2 c.f. min.	1	1	1	1

Hot and cold water dispensing unit. Disposable cups and bottled water shall be supplied by the Contractor for the duration of the project.	1	1	1	1
Microwave, 1.2 c.f. , 1000W min.	1	1	1	1
Fire extinguishers - provide and install type and *number to meet applicable State and local codes for size of office indicated, including a fire extinguisher suitable for use on a computer terminal fire.	*	*	*	*
Electric pencil sharpeners.	1	2	2	2
Electronic office type printing calculators capable of addition, subtraction, multiplication and division with memory and a supply of printing paper.	1	1	2	4
Small Multi-Function Laser Printer/Copier/Scanner/Fax combination unit, network capable, as specified below under Computer Related Hardware and Software.	1	1		
Large Multi-Function Laser Printer/Copier/Scanner/Fax combination unit, network capable, as specified below under Computer Related Hardware and Software.			1	1
Field Office Wi-Fi Connection as specified below under Computer Related Hardware and Software	1	1	1	1
Wi-Fi Printer as specified below under Computer Related Hardware and Software.	1	1	1	1
Digital Camera as specified below under Computer Related Hardware and Software.	1	1	3	3
Video Projector as specified below under Computer Related Hardware and Software.	-	-	-	1
Smart Board as specified below under Computer Related Hardware and Software.	-	-	-	1
Infrared Thermometer, including annual third party certified calibration, case, and cleaning wipes.	1	1	1	2
Concrete Curing Box as specified below under Concrete Testing Equipment.	1	1	1	1
Concrete Air Meter and accessories as specified below under Concrete Testing Equipment as specified below. Contractor shall provide third party calibration on a quarterly basis.	1	1	1	1
Concrete Slump Cone and accessories as specified below under Concrete Testing Equipment.	1	1	1	1
First Aid Kit	1	1	1	1
Flip Phones as specified under Computer Related Hardware and Software.	-	-	-	-
Smart Phones as specified under Computer Related Hardware and Software.	-	-	-	-

The furnishings and equipment required herein shall remain the property of the Contractor. Any supplies required to maintain or operate the above listed equipment or furnishings shall be provided by the Contractor for the duration of the project.

Computer Related Hardware and Software: The CTDOT will supply by its own means the actual Personal Computers for the CTDOT representatives. The Contractor shall supply the Field Office Wi-Fi Connection, Wi-Fi Printer, Digital Camera(s), Flip Phones, Smart Phones, Multifunction Laser Printer/Copier/Scanner/Fax, Video Projectors, and Smart Board(s) as well as associated hardware and software, must meet the requirements of this specification as well as the latest minimum specifications posted, as of the project advertising date, at CTDOTs web site http://www.ct.gov/dot/cwp/view.asp?a=1410&q=563904

Within 10 calendar days after the signing of the Contract but before ordering/purchasing the Wi-Fi Printer (separate from the Multifunction Laser Printer/Copier/Scanner/Fax), Field Office Wi-Fi, Digital Camera(s), Flip Phones, Smart Phones, Multifunction Laser Printer/Copier/Scanner/Fax, Video Projector(s) and Smart Board(s) as well as associated hardware, the Contractor must submit a copy of their proposed order(s) with catalog cuts and specifications to the Administering CTDOT District for review and approval. The Wi-Fi Printer, Wi-Fi Router, Flip Phones, Smart Phones, digital cameras, Projector(s) and Smart Board(s) will be reviewed by CTDOT District personnel. The Multifunction Laser Printer/Copier/Scanner/Fax will be reviewed by the CTDOT OIS. The Contractor shall not purchase the hardware, software, or services until the Administering CTDOT District informs them that the proposed equipment, software, and services are approved. The Contractor will be solely responsible for the costs of any hardware, software, or services purchased without approval.

The Contractor and/or their internet service provider shall be responsible for the installation and setup of the field office Wi-Fi, Wi-Fi printer, and the configuration of the wireless router as directed by the CTDOT. Installation will be coordinated with CTDOT District and Project personnel.

After the approval of the hardware and software, the Contractor shall contact the designated representatives of the CTDOT administering District, a minimum of 2 working days in advance of the proposed delivery or installation of the Field Office Wi-Fi Connection, Wi-Fi Printer, Digital Camera(s), Flip Phones, Smart Phones, Multifunction Laser Printer/Copier/Scanner/Fax, Video Projectors and Smart Board(s), as well as associated hardware, software, supplies, and support documentation.

The Contractor shall provide all supplies, paper, maintenance, service and repairs (including labor and parts) for the Wi-Fi printers, copiers, field office Wi-Fi, fax machines and other equipment and facilities required by this specification for the duration of the Contract. All repairs must be performed with-in 48 hours. If the repairs require more than a 48 hours then an equal or better replacement must be provided.

Once the Contract has been completed, the hardware and software will remain the property of the Contractor.

First Aid Kit: The Contractor shall supply a first aid kit adequate for the number of personnel expected based on the size of the field office specified and shall keep the first aid kit stocked for the duration that the field office is in service.

Rain Gauge: The Contractor shall supply install and maintain a rain gauge for the duration of the project, meeting these minimum requirements. The rain gauge shall be installed on the top of a post such that the opening of the rain gauge is above the top of the post an adequate distance to avoid splashing of rain water from the top of the post into the rain gauge. The Location of the rain gauge and post shall be approved by the Engineer. The rain gauge shall be made of a durable material and have graduations of 0.1 inches or less with a minimum total column height of 5 inches. If the rain gauge is damaged the Contractor shall replace it prior to the next forecasted storm event at no additional cost.

Concrete Testing Equipment: If the Contract includes items that require compressive strength cylinders for concrete, in accordance with the Schedule of Minimum Testing Requirements for Sampling Materials for Test, the Contractor shall provide the following equipment.

A) Concrete Cylinder Curing Box – meeting the requirements of Section 6.12 of the Standard Specifications.

B) Air Meter – The air meter provided shall be in good working order and meet the requirements of AASHTO T 152.

C) Slump Cone Mold – Slump cone, base plate, and tamping rod shall be provided in like-new condition and meet the requirements of AASHTO T119, Standard Test Method for Slump of Hydraulic-Cement Concrete.

All testing equipment will remain the property of the Contractor at the completion of the project.

Insurance Policy: The Contractor shall provide a separate insurance policy, with no deductible, in the minimum amount of five thousand dollars ($5,000) in order to insure all State-owned data equipment and supplies used in the office against all losses. The Contractor shall be named insured on that policy, and the CTDOT shall be an additional named insured on the policy. These losses shall include, but not be limited to: theft, fire, and physical damage. The CTDOT will be responsible for all maintenance costs of CTDOT owned computer hardware. In the event of loss, the Contractor shall provide replacement equipment in accordance with current CTDOT equipment specifications, within seven days of notice of the loss. If the Contractor is unable to provide the required replacement equipment within seven days, the CTDOT may provide replacement equipment and deduct the cost of the equipment from monies due or which may become due the Contractor under the Contract or under any other contract. The Contractor's financial liability under this paragraph shall be limited to the amount of the insurance coverage required by this paragraph. If the cost of equipment replacement required by this paragraph should exceed the required amount of the insurance coverage, the CTDOT will reimburse the Contractor for replacement costs exceeding the amount of the required coverage.

Maintenance: During the occupancy by the CTDOT, the Contractor shall maintain all facilities and furnishings provided under the above requirements, and shall maintain and keep the office

quarters clean through the use of weekly professional cleaning to include, but not limited to, washing & waxing floors, cleaning restrooms, removal of trash, etc. Exterior areas shall be mowed and clean of debris. A trash receptacle (dumpster) with weekly pickup (trash removal) shall be provided. Snow removal, sanding and salting of all parking, walkway, and entrance ways areas shall be accomplished during a storm if on a workday during work hours, immediately after a storm and prior to the start of a workday. If snow removal, salting and sanding are not completed by the specified time, the State will provide the service and all costs incurred will be deducted from the next payment estimate.

Method of Measurement: The furnishing and maintenance of the construction field office will be measured for payment by the number of calendar months that the office is in place and in operation, rounded up to the nearest month.

There will not be any price adjustment due to any change in the minimum computer related hardware and software requirements.

Basis of Payment: The furnishing and maintenance of the Construction Field Office will be paid for at the Contract unit price per month for "Construction Field Office, (Type)," which price shall include all material, equipment, labor, service contracts, licenses, software, repair or replacement of hardware and software, related supplies, utility services, parking area, external illumination, trash removal, snow and ice removal, and work incidental thereto, as well as any other costs to provide requirements of this specified this specification.

Pay Item	Pay Unit
Construction Field Office, (Type)	Month

ITEM #0970006A - TRAFFICPERSON (MUNICIPAL POLICE OFFICER)
ITEM #0970007A - TRAFFICPERSON (UNIFORMED FLAGGER)

9.70.01—Description: Under this item the Contractor shall provide the services of Trafficpersons of the type and number, and for such periods, as the Engineer approves for the control and direction of vehicular traffic and pedestrians. Traffic persons requested solely for the contractor's operational needs will not be approved for payment.

9.70.03—Construction Method: Prior to the start of operations on the project requiring the use of Trafficpersons, a meeting will be held with the Contractor, Trafficperson agency or firm, Engineer, and State Police, if applicable, to review the Trafficperson operations, lines of responsibility, and operating guidelines which will be used on the project. A copy of the municipality's billing rates for Municipal Police Officers and vehicles, if applicable, will be provided to the Engineer prior to start of work.

On a weekly basis, the Contractor shall inform the Engineer of their scheduled operations for the following week and the number of Trafficpersons requested. The Engineer shall review this schedule and approve the type and number of Trafficpersons required. In the event of an unplanned, emergency, or short term operation, the Engineer may approve the temporary use of properly clothed persons for traffic control until such time as an authorized Trafficperson may be obtained. In no case shall this temporary use exceed 8 hours for any particular operation.

If the Contractor changes or cancels any scheduled operations without prior notice of same as required by the agency providing the Trafficpersons, and such that Trafficperson services are no longer required, the Contractor will be responsible for payment at no cost to the Department of any show-up cost for any Trafficperson not used because of the change. Exceptions, as approved by the Engineer, may be granted for adverse weather conditions and unforeseeable causes beyond the control and without the fault or negligence of the Contractor.

Trafficpersons assigned to a work site are to only take direction from the Engineer.

Trafficpersons shall wear a high visibility safety garment that complies with OSHA, MUTCD, ASTM Standards and the safety garment shall have the words "Traffic Control" clearly visible on the front and rear panels (minimum letter size 2 inches (50 millimeters). Worn/faded safety garments that are no longer highly visible shall not be used. The Engineer shall direct the replacement of any worn/faded garment at no cost to the State.

A Trafficperson shall assist in implementing the traffic control specified in the Maintenance and Protection of Traffic contained elsewhere in these specifications or as directed by the Engineer. Any situation requiring a Trafficperson to operate in a manner contrary to the Maintenance and Protection of Traffic specification shall be authorized in writing by the Engineer.

Trafficpersons shall consist of the following types:

1. Uniformed Law Enforcement Personnel: Law enforcement personnel shall wear the high visibility safety garment provided by their law enforcement agency. If no high visibility safety garment is provided, the Contractor shall provide the law enforcement personnel with a garment meeting the requirements stated for the Uniformed Flaggers' garment.

Law Enforcement Personnel may be also be used to conduct motor vehicle enforcement operations in and around work areas as directed and approved by the Engineer.

Municipal Police Officers: Uniformed Municipal Police Officers shall be sworn Municipal Police Officers or Uniformed Constables who perform criminal law enforcement duties from the Municipality in which the project is located. Their services will also include an official Municipal Police vehicle when requested by the Engineer. Uniformed Municipal Police Officers will be used on non-limited access highways. If Uniformed Municipal Police Officers are unavailable, other Trafficpersons may be used when authorized in writing by the Engineer.
Uniformed Municipal Police Officers and requested Municipal Police vehicles will be used at such locations and for such periods as the Engineer deems necessary to control traffic operations and promote increased safety to motorists through the construction sites.

2. Uniformed Flagger: Uniformed Flaggers shall be persons who have successfully completed flagger training by the American Traffic Safety Services Association (ATSSA), National Safety Council (NSC) or other programs approved by the Engineer. A copy of the Flagger's training certificate shall be provided to the Engineer before the Flagger performs any work on the project. Uniformed Flaggers shall conform to Chapter 6E, Flagger Control, in the Manual of Uniformed Traffic Control Devices (MUTCD) and shall wear high-visibility safety apparel, use a STOP/SLOW paddle that is at least 18 inches (450 millimeters) in width with letters at least 6 inches (150 millimeters) high. The paddle shall be mounted on a pole of sufficient length to be 6 feet (1.8 meters) above the ground as measured from the bottom of the sign.

Uniformed Flaggers will only be used on non-limited access highways to control traffic operations when authorized in writing by the Engineer.

9.70.04—Method of Measurement: Services of Trafficpersons will be measured for payment by the actual number of hours for each person rendering services approved by the Engineer. These services shall include, however, only such trafficpersons as are employed within the limits of construction, project right of way of the project or along detours authorized by the Engineer to assist the motoring public through the construction work zone. Services for continued use of a detour or bypass beyond the limitations approved by the Engineer, for movement of construction vehicles and equipment, or at locations where traffic is unnecessarily restricted by the Contractor's method of operation, will not be measured for payment.

Trafficpersons shall not work more than twelve hours in any one 24 hour period. In case such services are required for more than twelve hours, additional Trafficpersons shall be furnished and measured for payment. In cases where the Trafficperson is an employee on the Contractor's

payroll, payment under the item "Trafficperson (Uniformed Flagger)" will be made only for those hours when the Contractor's employee is performing Trafficperson services.

Travel time will not be measured for payment for services provided by Uniformed Municipal Police Officers or Uniformed Flaggers.

Mileage fees associated with Trafficperson services will not be measured for payment.

Safety garments and STOP/SLOW paddles will not be measured for payment.

9.70.05—Basis of Payment: Trafficpersons will be paid in accordance with the schedule described herein.
There will be no direct payment for safety garments or STOP/SLOW paddles. All costs associated with furnishing safety garments and STOP/SLOW paddles shall be considered included in the general cost of the item.

1. Uniformed Law Enforcement Personnel: The sum of money shown on the Estimate and in the itemized proposal as "Estimated Cost" for this work will be considered the bid price even though payment will be made as described below. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount for the contract.

The Department will pay the Contractor its actual costs for "Trafficperson (Municipal Police Officer)" plus an additional 5% as reimbursement for the Contractor's administrative expense in connection with the services provided.

The invoice must include a breakdown of each officer's actual hours of work and actual rate applied. Mileage fees associated with Trafficperson services are not reimbursable expenses and are not to be included in the billing invoice. The use of a municipal police vehicle authorized by the Engineer will be paid at the actual rate charged by the municipality. Upon receipt of the invoice from the municipality, the Contractor shall forward a copy to the Engineer. The invoice will be reviewed and approved by the Engineer prior to any payments. *Eighty (80%) of the invoice will be paid upon completion of review and approval. The balance (20%) will be paid upon receipt of cancelled check or receipted invoice, as proof of payment.* The rate charged by the municipality for use of a uniformed municipal police officer and/or a municipal police vehicle shall not be greater than the rate it normally charges others for similar services.

2. Uniformed Flagger: Uniformed flaggers will be paid for at the contract unit price per hour for "Trafficperson (Uniformed Flagger)", which price shall include all compensation, insurance benefits and any other cost or liability incidental to the furnishing of the trafficpersons ordered.

Pay Item	Pay Unit
Trafficperson (Uniformed Flagger)	Hr.

ITEM #0971001A – MAINTENANCE AND PROTECTION OF TRAFFIC

Article 9.71.01 – Description is supplemented by the following:

The Contractor shall maintain and protect traffic as described by the following and as limited in the Special Provision "Prosecution and Progress":

All Project Roadways

The Contractor shall maintain and protect a minimum of one lane of traffic in each direction, each lane on a paved travel path not less than 11 feet in width.

Excepted therefrom will be those periods, during the allowable periods, when the Contractor is actively working, at which time the Contractor shall maintain and protect at least an alternating one-way traffic operation, on a paved travel path not less than 12 feet in width. The length of the alternating one-way traffic operation shall not exceed 300 feet and there shall be no more than one alternating one-way traffic operation within the project limits without prior approval of the Engineer.

Commercial and Residential Driveways

The Contractor shall maintain access to and egress from all commercial and residential driveways throughout the project limits. The Contractor will be allowed to close said driveways to perform the required work during those periods when the businesses are closed, unless permission is granted from the business owner to close the driveway during business hours. If a temporary closure of a residential driveway is necessary, the Contractor shall coordinate with the owner to determine the time period of the closure.

Article 9.71.03 - Construction Method is supplemented as follows:

General

The Contractor is required to delineate any raised structures within the travel lanes, so that the structures are visible day and night, unless there are specific contract plans and provisions to temporarily lower these structures prior to the completion of work.

The Contractor shall schedule operations so that pavement removal and roadway resurfacing shall be completed full width across a roadway (bridge) section by the end of a workday (work night), or as directed by the Engineer.

When the installation of all intermediate courses of bituminous concrete pavement is completed for the entire roadway, the Contractor shall install the final course of bituminous concrete pavement.

When the Contractor is excavating adjacent to the roadway, the Contractor shall provide a 3-foot shoulder between the work area and travel lanes, with traffic drums spaced every 50 feet. At the end of the workday, if the vertical drop-off exceeds 3 inches, the Contractor shall provide a temporary traversable slope of 4:1 or flatter that is acceptable to the Engineer.

If applicable, when an existing sign is removed, it shall be either relocated or replaced by a new sign during the same working day.

The Contractor shall not store any material on-site which would present a safety hazard to motorists or pedestrians (e.g. fixed object or obstruct sight lines).

The field installation of a signing pattern shall constitute interference with existing traffic operations and shall not be allowed, except during the allowable periods.

Existing Signing

The Contractor shall maintain all existing overhead and side-mounted signs throughout the project limits during the duration of the project. The Contractor shall temporarily relocate signs and sign supports as many times as deemed necessary, and install temporary sign supports if necessary and as directed by the Engineer.

Requirements for Winter

The Contractor shall schedule a meeting with representatives from the Department including the offices of Maintenance and Traffic, and the Town/City to determine what interim traffic control measures the Contractor shall accomplish for the winter to provide safety to the motorists and permit adequate snow removal procedures. This meeting shall be held prior to October 31 of each year and will include, but not be limited to, discussion of the status and schedule of the following items: lane and shoulder widths, pavement restoration, traffic signal work, pavement markings, and signing.

Signing Patterns

The Contractor shall erect and maintain all signing patterns in accordance with the traffic control plans contained herein. Proper distances between advance warning signs and proper taper lengths are mandatory.

Pavement Markings

The Contractor will be responsible for the furnishing of all pavement markings, either temporary or permanent. The Contractor shall repaint roadways as directed by the engineer. This work will be paid for under the appropriate pavement marking items.

The Contractor is alerted that all pavement markings must be in place by the end of the work day for any roadway to be opened on that day.

TRAFFIC CONTROL DURING CONSTRUCTION OPERATIONS

The following guidelines shall assist field personnel in determining when and what type of traffic control patterns to use for various situations. These guidelines shall provide for the safe and efficient movement of traffic through work zones and enhance the safety of work forces in the work area.

TRAFFIC CONTROL PATTERNS

Traffic control patterns shall be used when a work operation requires that all or part of any vehicle or work area protrudes onto any part of a travel lane or shoulder. For each situation, the installation of traffic control devices shall be based on the following:

Speed and volume of traffic
Duration of operation
Exposure to hazards

Traffic control patterns shall be uniform, neat and orderly so as to command respect from the motorist.

In the case of a horizontal or vertical sight restriction in advance of the work area, the traffic control pattern shall be extended to provide adequate sight distance for approaching traffic.

If a lane reduction taper is required to shift traffic, the entire length of the taper should be installed on a tangent section of roadway so that the entire taper area can be seen by the motorist.

Any existing signs that are in conflict with the traffic control patterns shall be removed, covered, or turned so that they are not readable by oncoming traffic.

When installing a traffic control pattern, a Buffer Area should be provided and this area shall be free of equipment, workers, materials and parked vehicles.

Typical traffic control plans 19 through 25 may be used for moving operations such as line striping, pot hole patching, mowing, or sweeping when it is necessary for equipment to occupy a travel lane.

Traffic control patterns will not be required when vehicles are on an emergency patrol type activity or when a short duration stop is made and the equipment can be contained within the shoulder. Flashing lights and appropriate trafficperson shall be used when required.

Although each situation must be dealt with individually, conformity with the typical traffic control plans contained herein is required. In a situation not adequately covered by the typical traffic control plans, the Contractor must contact the Engineer for assistance prior to setting up a traffic control pattern.

PLACEMENT OF SIGNS

Signs must be placed in such a position to allow motorists the opportunity to reduce their speed prior to the work area. Signs shall be installed on the same side of the roadway as the work area. On multi-lane divided highways, advance warning signs shall be installed on both sides of the highway. On directional roadways (on-ramps, off-ramps, one-way roads), where the sight distance to signs is restricted, these signs should be installed on both sides of the roadway.

ALLOWABLE ADJUSTMENT OF SIGNS AND DEVICES SHOWN ON THE TRAFFIC CONTROL PLANS

The traffic control plans contained herein show the location and spacing of signs and devices under ideal conditions. Signs and devices should be installed as shown on these plans whenever possible.

The proper application of the traffic control plans and installation of traffic control devices depends on actual field conditions.

Adjustments to the traffic control plans shall be made only at the direction of the Engineer to improve the visibility of the signs and devices and to better control traffic operations. Adjustments to the traffic control plans shall be based on safety of work forces and motorists, abutting property requirements, driveways, side roads, and the vertical and horizontal curvature of the roadway.

The Engineer may require that the traffic control pattern be located significantly in advance of the work area to provide better sight line to the signing and safer traffic operations through the work zone.

Table I indicates the minimum taper length required for a lane closure based on the posted speed limit of the roadway. These taper lengths shall only be used when the recommended taper lengths shown on the traffic control plans cannot be achieved.

TABLE I – MINIMUM TAPER LENGTHS

POSTED SPEED LIMIT MILES PER HOUR	MINIMUM TAPER LENGTH IN FEET FOR A SINGLE LANE CLOSURE
30 OR LESS	180
35	250
40	320
45	540
50	600
55	660
65	780

SECTION 1. WORK ZONE SAFETY MEETINGS

1.a) Prior to the commencement of work, a work zone safety meeting will be conducted with representatives of DOT Construction, Connecticut State Police (Local Barracks), Municipal Police, the Contractor (Project Superintendent) and the Traffic Control Subcontractor (if different than the prime Contractor) to review the traffic operations, lines of responsibility, and operating guidelines which will be used on the project. Other work zone safety meetings during the course of the project should be scheduled as needed.

1.b) A Work Zone Safety Meeting Agenda shall be developed and used at the meeting to outline the anticipated traffic control issues during the construction of this project. Any issues that can't be resolved at these meetings will be brought to the attention of the District Engineer and the Office of Construction. The agenda should include:

- Review Project scope of work and time
- Review Section 1.08, Prosecution and Progress
- Review Section 9.70, Trafficpersons
- Review Section 9.71, Maintenance and Protection of Traffic
- Review Contractor's schedule and method of operations.
- Review areas of special concern: ramps, turning roadways, medians, lane drops, etc.
- Open discussion of work zone questions and issues
- Discussion of review and approval process for changes in contract requirements as they relate to work zone areas

SECTION 2. GENERAL

2.a) If the required minimum number of signs and equipment (i.e. one High Mounted Internally Illuminated Flashing Arrow for each lane closed, two TMAs, Changeable Message Sign, etc.) are not available; the traffic control pattern shall not be installed.

2.b) The Contractor shall have back-up equipment (TMAs, High Mounted Internally Illuminated Flashing Arrow, Changeable Message Sign, construction signs, cones/drums, etc.) available at all times in case of mechanical failures, etc. The only exception to this is in the case of sudden equipment breakdowns in which the pattern may be installed but the Contractor must provide replacement equipment within 24 hours.

2.c) Failure of the Contractor to have the required minimum number of signs, personnel and equipment, which results in the pattern not being installed, shall not be a reason for a time extension or claim for loss time.

2.d) In cases of legitimate differences of opinion between the Contractor and the Inspection staff, the Inspection staff shall err on the side of safety. The matter shall be brought to

the District Office for resolution immediately or, in the case of work after regular business hours, on the next business day.

SECTION 3. INSTALLING AND REMOVING TRAFFIC CONTROL PATTERNS

3.a) Lane Closures shall be installed beginning with the advance warning signs and proceeding forward toward the work area.

3.b) Lane Closures shall be removed in the reverse order, beginning at the work area, or end of the traffic control pattern, and proceeding back toward the advance warning signs.

3.c) Stopping traffic may be allowed:

- As per the contract for such activities as blasting, steel erection, etc.
- During paving, milling operations, etc. where, in the middle of the operation, it is necessary to flip the pattern to complete the operation on the other half of the roadway and traffic should not travel across the longitudinal joint or difference in roadway elevation.
- To move slow moving equipment across live traffic lanes into the work area.

3.d) Under certain situations when the safety of the traveling public and/or that of the workers may be compromised due to conditions such as traffic volume, speed, roadside obstructions, or sight line deficiencies, as determined by the Engineer and/or State Police, traffic may be briefly impeded while installing and/or removing the advance warning signs and the first ten traffic cones/drums only. Appropriate measures shall be taken to safely slow traffic. If required, traffic slowing techniques may be used and shall include the use of Truck Mounted Impact Attenuators (TMAs) as appropriate, for a minimum of one mile in advance of the pattern starting point. Once the advance warning signs and the first ten traffic cones/drums are installed/removed, the TMAs and sign crew shall continue to install/remove the pattern as described in Section 5 and traffic shall be allowed to resume their normal travel.

3.e) The Contractor must adhere to using the proper signs, placing the signs correctly, and ensuring the proper spacing of signs.

3.f) Additional devices are required on entrance ramps, exit ramps, and intersecting roads to warn and/or move traffic into the proper travelpath prior to merging/exiting with/from the main line traffic. This shall be completed before installing the mainline pattern past the ramp or intersecting roadway.

3.g) Prior to installing a pattern, any conflicting existing signs shall be covered with an opaque material. Once the pattern is removed, the existing signs shall be uncovered.

3.h) On limited access roadways, workers are prohibited from crossing the travel lanes to install and remove signs or other devices on the opposite side of the roadway. Any signs or devices on the opposite side of the roadway shall be installed and removed separately.

SECTION 4. USE OF HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

4.a) On limited access roadways, one Flashing Arrow shall be used for each lane that is closed. The Flashing Arrow shall be installed concurrently with the installation of the traffic control pattern and its placement shall be as shown on the traffic control plan. For multiple lane closures, one Flashing Arrow is required for each lane closed. If conditions warrant, additional Flashing Arrows should be employed (i.e.: curves, major ramps, etc.).

4.b) On non-limited access roadways, the use of a Flashing Arrow for lane closures is optional. The roadway geometry, sight line distance, and traffic volume should be considered in the decision to use the Flashing Arrow.

4.c) The Flashing Arrow shall not be used on two lane, two-way roadways for temporary alternating one-way traffic operations.

4.d) The Flashing Arrow board display shall be in the "arrow" mode for lane closure tapers and in the "caution" mode (four corners) for shoulder work, blocking the shoulder, or roadside work near the shoulder. The Flashing Arrow shall be in the "caution" mode when it is positioned in the closed lane.

4.e) The Flashing Arrow shall not be used on a multi-lane roadway to laterally shift all lanes of traffic, because unnecessary lane changing may result.

SECTION 5. USE OF TRUCK MOUNTED IMPACT ATTENUATOR VEHICLES (TMAs)

5.a) For lane closures on limited access roadways, a minimum of two TMAs shall be used to install and remove traffic control patterns. If two TMAs are not available, the pattern shall not be installed.

5.b) On non-limited access roadways, the use of TMAs to install and remove patterns closing a lane(s) is optional. The roadway geometry, sight line distance, and traffic volume should be considered in the decision to utilize the TMAs.

5.c) Generally, to establish the advance and transition signing, one TMA shall be placed on the shoulder and the second TMA shall be approximately 1,000 feet ahead blocking the lane. The flashing arrow board mounted on the TMA should be in the "flashing arrow" mode when taking the lane. The sign truck and workers should be immediately ahead of

the second TMA. In no case shall the TMA be used as the sign truck or a work truck. Once the transition is in place, the TMAs shall travel in the closed lane until all Changeable Message Signs, signs, Flashing Arrows, and cones/drums are installed. The flashing arrow board mounted on the TMA should be in the "caution" mode when traveling in the closed lane.

5.d) A TMA shall be placed prior to the first work area in the pattern. If there are multiple work areas within the same pattern, then additional TMAs shall be positioned at each additional work area as needed. The flashing arrow board mounted on the TMA should be in the "caution" mode when in the closed lane.

5.e) TMAs shall be positioned a sufficient distance prior to the workers or equipment being protected to allow for appropriate vehicle roll-ahead in the event that the TMA is hit, but not so far that an errant vehicle could travel around the TMA and into the work area. For additional placement and use details, refer to the specification entitled "Type 'D' Portable Impact Attenuation System". Some operations, such as paving and concrete repairs, do not allow for placement of the TMA(s) within the specified distances. In these situations, the TMA(s) should be placed at the beginning of the work area and shall be advanced as the paving or concrete operations proceed.

5.f) TMAs should be paid in accordance with how the unit is utilized. When it is used as a TMA and is in the proper location as specified, and then it should be paid at the specified hourly rate for "Type 'D' Portable Impact Attenuation System". When the TMA is used as a Flashing Arrow, it should be paid at the daily rate for "High Mounted Internally Illuminated Flashing Arrow". If a TMA is used to install and remove a pattern and then is used as a Flashing Arrow, the unit should be paid as a "Type 'D' Portable Impact Attenuation System" for the hours used to install and remove the pattern, typically 2 hours (1 hour to install and 1 hour to remove), and is also paid for the day as a "High Mounted Internally Illuminated Flashing Arrow".

SECTION 6. USE OF TRAFFIC DRUMS AND TRAFFIC CONES

6.a) Traffic drums shall be used for taper channelization on limited-access roadways, ramps, and turning roadways and to delineate raised catch basins and other hazards.

6.b) Traffic drums shall be used in place of traffic cones in traffic control patterns that are in effect for more than a 36-hour duration.

6.c) Traffic Cones less than 42 inches in height shall not be used on limited-access roadways or on non-limited access roadways with a posted speed limit of 45 mph and above.

6.d) Typical spacing of traffic drums and/or cones shown on the Traffic Control Plans in the Contract are maximum spacings and may be reduced to meet actual field conditions as required.

SECTION 7. USE OF (REMOTE CONTROLLED) CHANGEABLE MESSAGE SIGNS (CMS)

7.a) For lane closures on limited access roadways, one CMS shall be used in advance of the traffic control pattern. Prior to installing the pattern, the CMS shall be installed and in operation, displaying the appropriate lane closure information (i.e.: Left Lane Closed - Merge Right). The CMS shall be positioned ½ - 1 mile ahead of the lane closure taper. If the nearest Exit ramp is greater than the specified ½ - 1 mile distance, than an additional CMS shall be positioned a sufficient distance ahead of the Exit ramp to alert motorists to the work and therefore offer them an opportunity to take the exit.

7.b) CMS should not be installed within 1000 feet of an existing CMS.

7.c) On non-limited access roadways, the use of CMS for lane closures is optional. The roadway geometry, sight line distance, and traffic volume should be considered in the decision to use the CMS.

7.d) The advance CMS is typically placed off the right shoulder, 5 feet from the edge of pavement. In areas where the CMS cannot be placed beyond the edge of pavement, it may be placed on the paved shoulder with a minimum of five (5) traffic drums placed in a taper in front of it to delineate its position. The advance CMS shall be adequately protected if it is used for a continuous duration of 36 hours or more.

7.e) When the CMS are no longer required, they should be removed from the clear zone and have the display screen cleared and turned 90° away from the roadway.

7.f) The CMS generally should not be used for generic messages (ex: Road Work Ahead, Bump Ahead, Gravel Road, etc.).

7.g) The CMS should be used for specific situations that need to command the motorist's attention which cannot be conveyed with standard construction signs (Examples include: Exit 34 Closed Sat/Sun - Use Exit 35, All Lanes Closed - Use Shoulder, Workers on Road - Slow Down).

7.h) Messages that need to be displayed for long periods of time, such as during stage construction, should be displayed with construction signs. For special signs, please coordinate with the Office of Construction and the Division of Traffic Engineering for the proper layout/dimensions required.

7.i) The messages that are allowed on the CMS are as follows:

Message No.	Frame 1	Frame 2	Message No.	Frame 1	Frame 2
1	LEFT LANE CLOSED	MERGE RIGHT	9	LANES CLOSED AHEAD	REDUCE SPEED
2	2 LEFT LANES CLOSED	MERGE RIGHT	10	LANES CLOSED AHEAD	USE CAUTION
3	LEFT LANE CLOSED	REDUCE SPEED	11	WORKERS ON ROAD	REDUCE SPEED
4	2 LEFT LANES CLOSED	REDUCE SPEED	12	WORKERS ON ROAD	SLOW DOWN
5	RIGHT LANE CLOSED	MERGE LEFT	13	EXIT XX CLOSED	USE EXIT YY
6	2 RIGHT LANES CLOSED	MERGE LEFT	14	EXIT XX CLOSED USE YY	FOLLOW DETOUR
7	RIGHT LANE CLOSED	REDUCE SPEED	15	2 LANES SHIFT AHEAD	USE CAUTION
8	2 RIGHT LANES CLOSED	REDUCE SPEED	16	3 LANES SHIFT AHEAD	USE CAUTION

For any other message(s), approval must be received from the Office of Construction prior to their use. No more than two (2) displays shall be used within any message cycle.

SECTION 8. USE OF STATE POLICE OFFICERS

8.a) State Police may be utilized only on limited access highways and secondary roadways under their primary jurisdiction. One Officer may be used per critical sign pattern. Shoulder closures and right lane closures can generally be implemented without the presence of a State Police Officer. Likewise in areas with moderate traffic and wide, unobstructed medians, left lane closures can be implemented without State Police presence. Under some situations it may be desirable to have State Police presence, when one is available. Examples of this include: nighttime lane closures; left lane closures with minimal width for setting up advance signs and staging; lane and shoulder closures on turning roadways/ramps or mainline where sight distance is minimal; and closures where extensive turning movements or traffic congestion regularly occur, however they are not required.

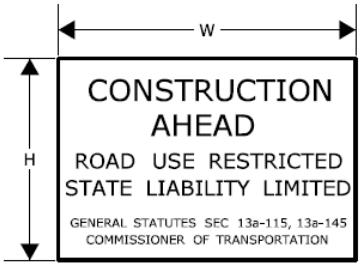
8.b) Once the pattern is in place, the State Police Officer should be positioned in a non-hazardous location in advance of the pattern If traffic backs up beyond the beginning of the pattern, then the State Police Officer shall be repositioned prior to the backup to give warning to the oncoming motorists. The State Police Officer and TMA should not be in proximity to each other.

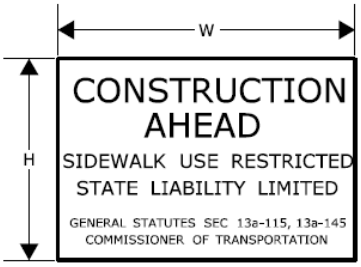
8.c) Other functions of the State Police Officer(s) may include:

- Assisting entering/exiting construction vehicles within the work area.
- Enforcement of speed and other motor vehicle laws within the work area, if specifically requested by the project.

8.d) State Police Officers assigned to a work site are to only take direction from the Engineer.

SERIES 16 SIGNS





		W H
16-E	80-1605	84" x 60"
16-H	80-1608	60" x 42"
16-M	80-1613	30" x 24"

		W H
16-S	80-1619	48" x 30"

THE 16-S SIGN SHALL BE USED ON ALL PROJECTS THAT REQUIRE SIDEWALK RECONSTRUCTION OR RESTRICT PEDESTRIAN TRAVEL ON AN EXISTING SIDEWALK.

SERIES 16 SIGNS SHALL BE INSTALLED IN ADVANCE OF THE TRAFFIC CONTROL PATTERNS TO ALLOW MOTORISTS THE OPPORTUNITY TO AVOID A WORK ZONE. SERIES 16 SIGNS SHALL BE INSTALLED ON ANY MAJOR INTERSECTING ROADWAYS THAT APPROACH THE WORK ZONE. ON LIMITED-ACCESS HIGHWAYS, THESE SIGNS SHALL BE LOCATED IN ADVANCE OF THE NEAREST UPSTREAM EXIT RAMP AND ON ANY ENTRANCE RAMPS PRIOR TO OR WITHIN THE WORK ZONE LIMITS.

THE LOCATION OF SERIES 16 SIGNS CAN BE FOUND ELSEWHERE IN THE PLANS OR INSTALLED AS DIRECTED BY THE ENGINEER.

SIGNS 16-E AND 16-H SHALL BE POST-MOUNTED.

SIGN 16-E SHALL BE USED ON ALL EXPRESSWAYS.

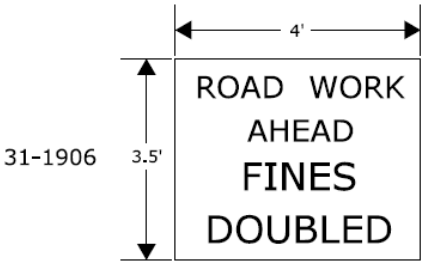
SIGN 16-H SHALL BE USED ON ALL RAMPS, OTHER STATE ROADWAYS, AND MAJOR TOWN/CITY ROADWAYS.

SIGN 16-M SHALL BE USED ON OTHER TOWN ROADWAYS.

REGULATORY SIGN "ROAD WORK AHEAD, FINES DOUBLED"

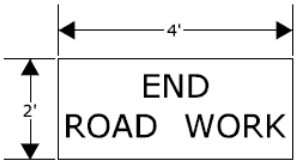
THE REGULATORY SIGN "ROAD WORK AHEAD FINES DOUBLED" SHALL BE INSTALLED FOR ALL WORK ZONES THAT OCCUR ON ANY STATE HIGHWAY IN CONNECTICUT WHERE THERE ARE WORKERS ON THE HIGHWAY OR WHEN THERE IS OTHER THAN EXISTING TRAFFIC OPERATIONS.

THE "ROAD WORK AHEAD FINES DOUBLED" REGULATORY SIGN SHALL BE PLACED AFTER THE SERIES 16 SIGN AND IN ADVANCE OF THE "ROAD WORK AHEAD" SIGN.



"END ROAD WORK" SIGN

THE LAST SIGN IN THE PATTERN MUST BE THE "END ROAD WORK" SIGN.



SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

REQUIRED SIGNS

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 11:35:43-04'00'
PRINCIPAL ENGINEER

NOTES FOR TRAFFIC CONTROL PLANS

1. IF A TRAFFIC STOPPAGE OCCURS IN ADVANCE OF SIGN (A), THEN AN ADDITIONAL SIGN (A) SHALL BE INSTALLED IN ADVANCE OF THE STOPPAGE.

2. SIGNS (AA), (A), AND (D) SHOULD BE OMITTED WHEN THESE SIGNS HAVE ALREADY BEEN INSTALLED TO DESIGNATE A LARGER WORK ZONE THAN THE WORK ZONE THAT IS ENCOMPASSED ON THIS PLAN.

3. SEE TABLE 1 FOR ADJUSTMENT OF TAPERS IF NECESSARY.

4. IF THIS PLAN REMAINS IN CONTINUOUS OPERATION FOR MORE THAN 36 HOURS, THEN TRAFFIC DRUMS SHALL BE USED IN PLACE OF TRAFFIC CONES.

5. ANY LEGAL SPEED LIMIT SIGNS WITHIN THE LIMITS OF A ROADWAY / LANE CLOSURE AREA SHALL BE COVERED WITH AN OPAQUE MATERIAL WHILE THE CLOSURE IS IN EFFECT, AND UNCOVERED WHEN THE ROADWAY / LANE CLOSURE IS RE-OPENED TO ALL LANES OF TRAFFIC.

6. IF THIS PLAN REMAINS IN CONTINUOUS OPERATION FOR MORE THAN 36 HOURS, THEN ANY EXISTING CONFLICTING PAVEMENT MARKINGS SHALL BE ERADICATED OR COVERED, AND TEMPORARY PAVEMENT MARKINGS THAT DELINEATE THE PROPER TRAVELPATHS SHALL BE INSTALLED.

7. DISTANCES BETWEEN SIGNS IN THE ADVANCE WARNING AREA MAY BE REDUCED TO 100' ON LOW-SPEED URBAN ROADS (SPEED LIMIT < 40 MPH).

8. IF THIS PLAN IS TO REMAIN IN OPERATION DURING THE HOURS OF DARKNESS, INSTALL BARRICADE WARNING LIGHTS - HIGH INTENSITY ON ALL POST-MOUNTED DIAMOND SIGNS IN THE ADVANCE WARNING AREA.

9. A CHANGEABLE MESSAGE SIGN SHALL BE INSTALLED ONE HALF TO ONE MILE IN ADVANCE OF THE LANE CLOSURE TAPER.

10 SIGN (P) SHALL BE MOUNTED A MINIMUM OF 7 FEET FROM THE PAVEMENT SURFACE TO THE BOTTOM OF THE SIGN.

TABLE 1 - MINIMUM TAPER LENGTHS

POSTED SPEED LIMIT (MILES PER HOUR)	MINIMUM TAPER LENGTH FOR A SINGLE LANE CLOSURE
30 OR LESS	180' (55m)
35	250' (75m)
40	320' (100m)
45	540' (165m)
50	600' (180m)
55	660' (200m)
65	780' (240m)

METRIC CONVERSION CHART (1" = 25mm)

ENGLISH	METRIC	ENGLISH	METRIC	ENGLISH	METRIC
12"	300mm	42"	1050mm	72"	1800mm
18"	450mm	48"	1200mm	78"	1950mm
24"	600mm	54"	1350mm	84"	2100mm
30"	750mm	60"	1500mm	90"	2250mm
36"	900mm	66"	1650mm	96"	2400mm

SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

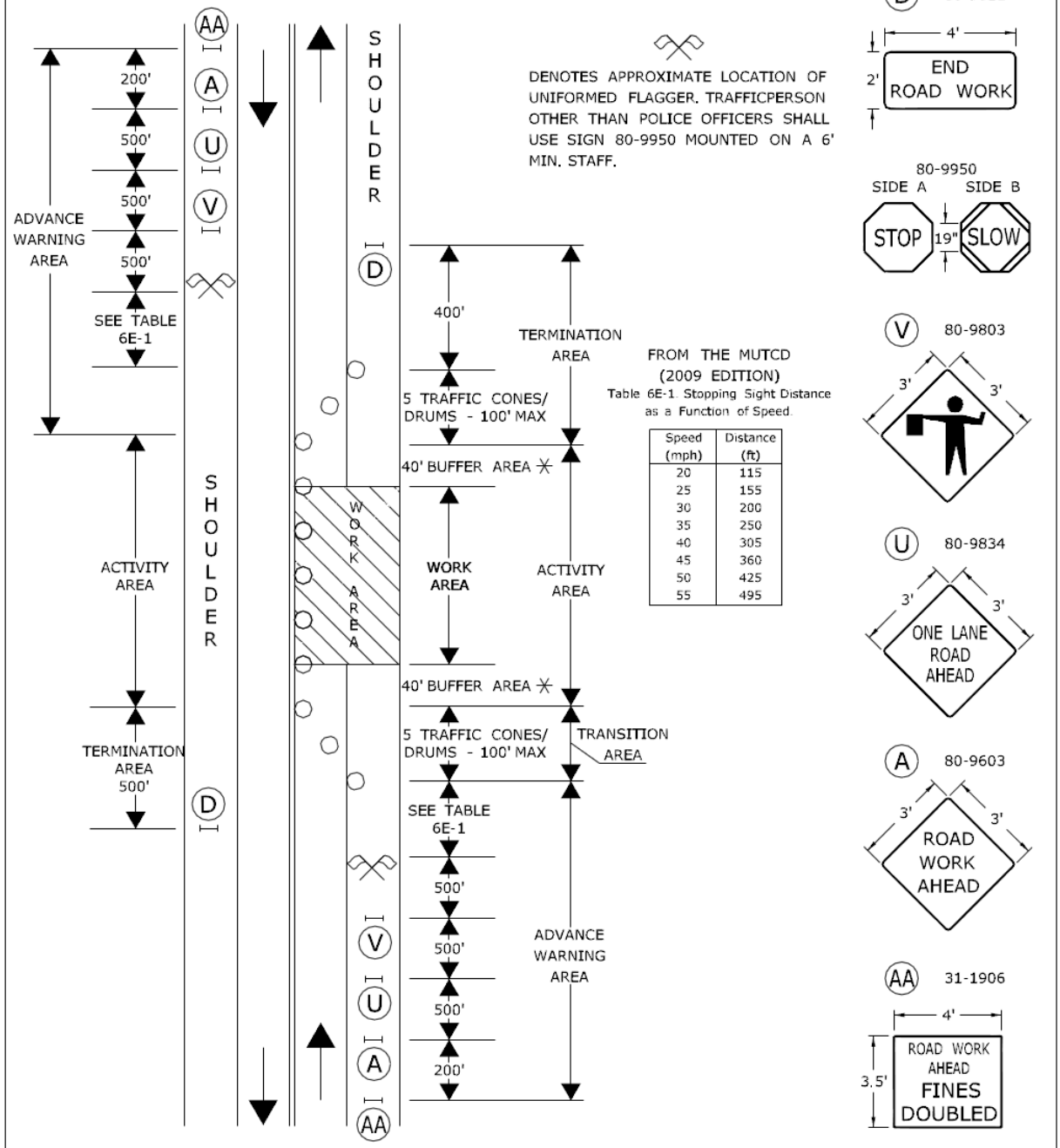
NOTES

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 15:50:35-04'00'
PRINCIPAL ENGINEER

WORK IN TRAVEL LANE AND SHOULDER
TWO LANE HIGHWAY
ALTERNATING ONE-WAY TRAFFIC OPERATIONS

SIGN FACE
108 SQ. FT (MIN.)



TRAFFIC CONE **OR** TRAFFIC DRUM
OPTIONAL TRAFFIC DRUM PORTABLE SIGN SUPPORT
HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

PLAN 13 - SHEET 1 OF 2

SEE NOTES 1, 2, 4, 6, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 15:55:23-04'00'
PRINCIPAL ENGINEER

WORK IN TRAVEL LANE AND SHOULDER
TWO LANE HIGHWAY
ALTERNATING ONE-WAY TRAFFIC OPERATIONS

SIGN FACE
108 SQ. FT (MIN.)

HAND SIGNAL METHODS TO BE USED BY UNIFORMED FLAGGERS

THE FOLLOWING METHODS FROM SECTION 6E.07, FLAGGER PROCEDURES, IN THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES," SHALL BE USED BY UNIFORMED FLAGGERS WHEN DIRECTING TRAFFIC THROUGH A WORK AREA. THE STOP/SLOW SIGN PADDLE (SIGN NO. 80-9950) SHOWN ON THE TRAFFIC STANDARD SHEET TR-1220 01 ENTITLED, "SIGNS FOR CONSTRUCTION AND PERMIT OPERATIONS" SHALL BE USED.

A. TO STOP TRAFFIC

TO STOP ROAD USERS, THE FLAGGER SHALL FACE ROAD USERS AND AIM THE STOP PADDLE FACE TOWARD ROAD USERS IN A STATIONARY POSITION WITH THE ARM EXTENDED HORIZONTALLY AWAY FROM THE BODY. THE FREE ARM SHALL BE HELD WITH THE PALM OF THE HAND ABOVE SHOULDER LEVEL TOWARD APPROACHING TRAFFIC.

B. TO DIRECT TRAFFIC TO PROCEED

TO DIRECT STOPPED ROAD USERS TO PROCEED, THE FLAGGER SHALL FACE ROAD USERS WITH THE SLOW PADDLE FACE AIMED TOWARD ROAD USERS IN A STATIONARY POSITION WITH THE ARM EXTENDED HORIZONTALLY AWAY FROM THE BODY. THE FLAGGER SHALL MOTION WITH THE FREE HAND FOR ROAD USERS TO PROCEED.

C. TO ALERT OR SLOW TRAFFIC

TO ALERT OR SLOW TRAFFIC, THE FLAGGER SHALL FACE ROAD USERS WITH THE SLOW PADDLE FACE AIMED TOWARD ROAD USERS IN A STATIONARY POSITION WITH THE ARM EXTENDED HORIZONTALLY AWAY FROM THE BODY. TO FURTHER ALERT OR SLOW TRAFFIC, THE FLAGGER HOLDING THE SLOW PADDLE FACE TOWARD ROAD USERS MAY MOTION UP AND DOWN WITH THE FREE HAND, PALM DOWN.

◯ TRAFFIC CONE **OR** TRAFFIC DRUM
✳ OPTIONAL ⊗ TRAFFIC DRUM ⊢⊣ PORTABLE SIGN SUPPORT
⟵ HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

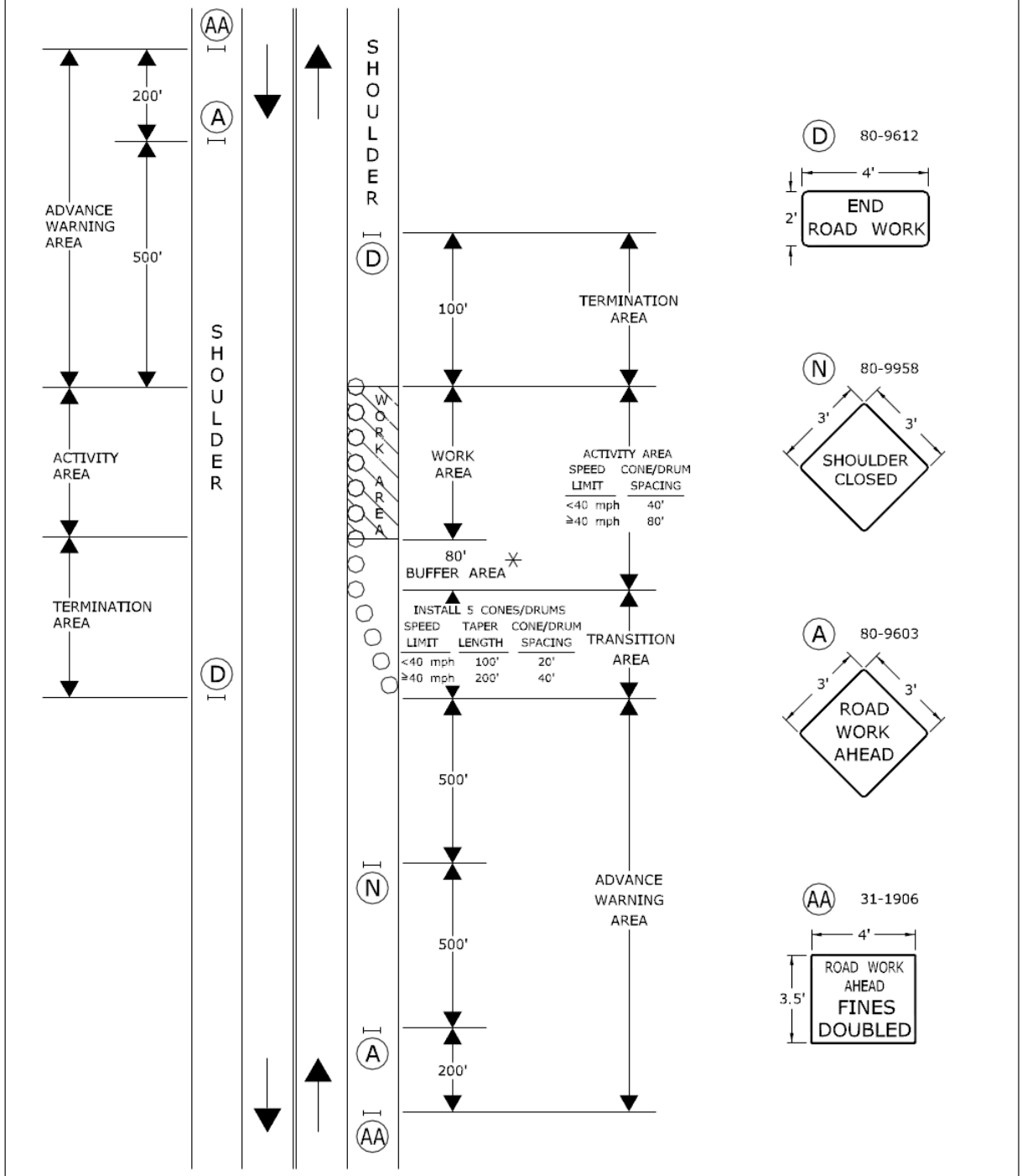
CONSTRUCTION TRAFFIC CONTROL PLAN
PLAN 13 - SHEET 2 OF 2
SEE NOTES 1, 2, 4, 6, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 15:55:45-04'00'
PRINCIPAL ENGINEER

WORK IN SHOULDER - TWO LANE HIGHWAY

SIGN FACE
71 SQ. FT (MIN.)



TRAFFIC CONE **OR** TRAFFIC DRUM
OPTIONAL TRAFFIC DRUM PORTABLE SIGN SUPPORT
HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

PLAN 14

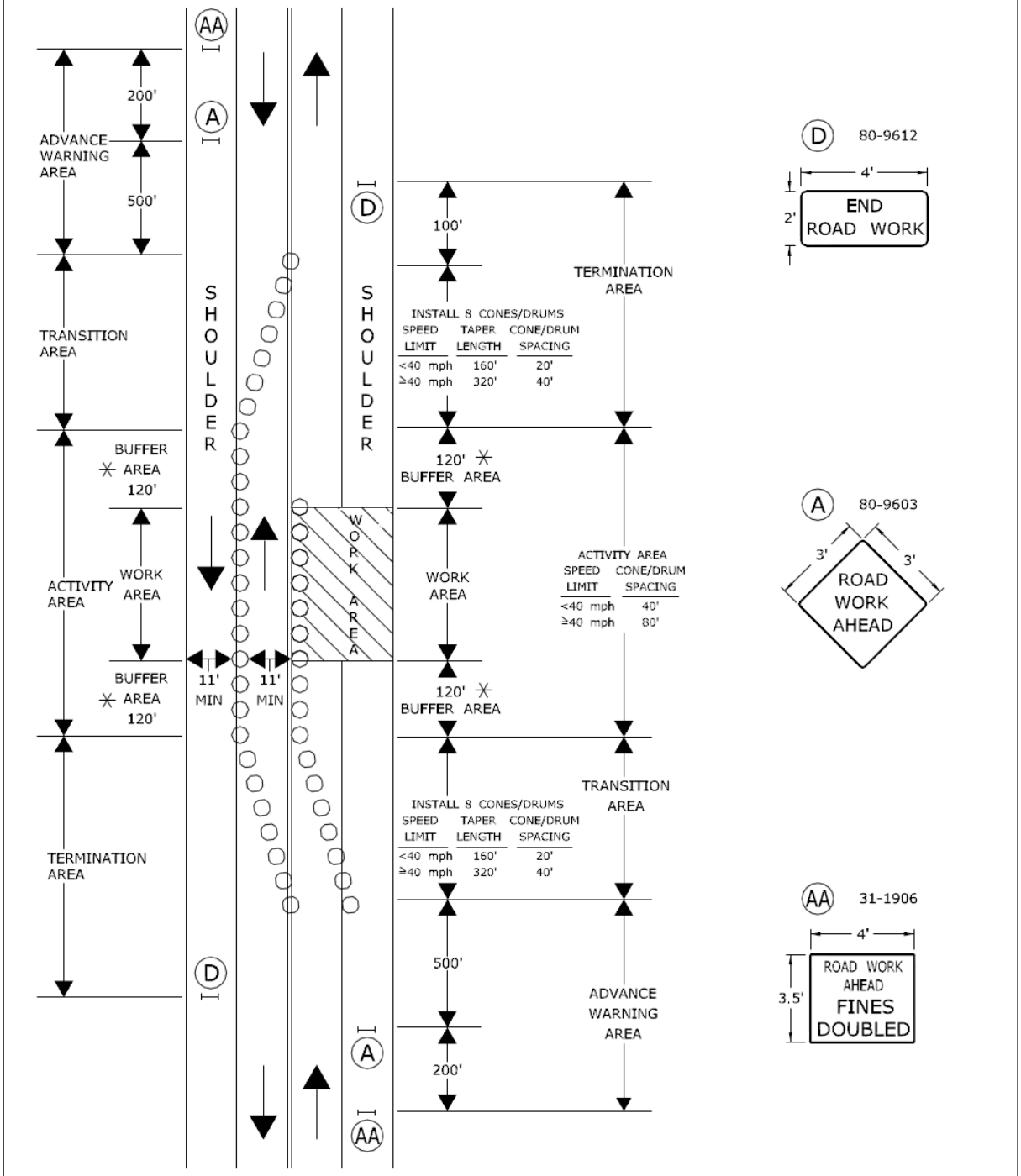
SEE NOTES 1, 2, 4, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 15:56:09-04'00'
PRINCIPAL ENGINEER

WORK IN TRAVEL LANE AND SHOULDER
TWO LANE HIGHWAY

SIGN FACE
62 SQ. FT (MIN.)



TRAFFIC CONE **OR** TRAFFIC DRUM
OPTIONAL TRAFFIC DRUM PORTABLE SIGN SUPPORT
HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

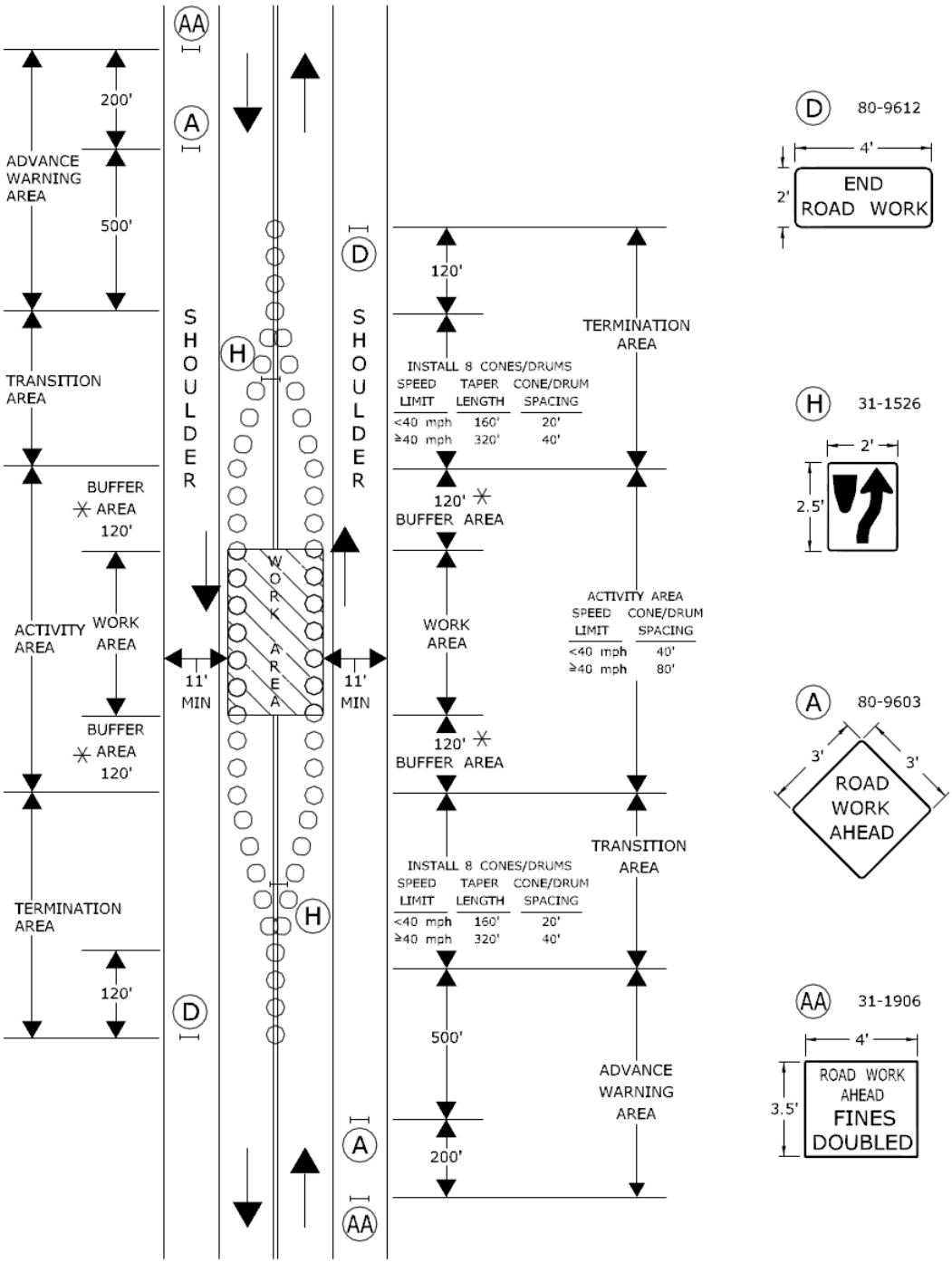
CONSTRUCTION TRAFFIC CONTROL PLAN
PLAN 15
SEE NOTES 1, 2, 4, 6, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 15:56:29-04'00'
PRINCIPAL ENGINEER

WORK IN MIDDLE OF ROADWAY
TWO LANE HIGHWAY

SIGN FACE
72 SQ. FT (MIN.)



◯ TRAFFIC CONE **OR** TRAFFIC DRUM
✳ OPTIONAL ⊗ TRAFFIC DRUM ⊢⊣ PORTABLE SIGN SUPPORT
⟵ HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

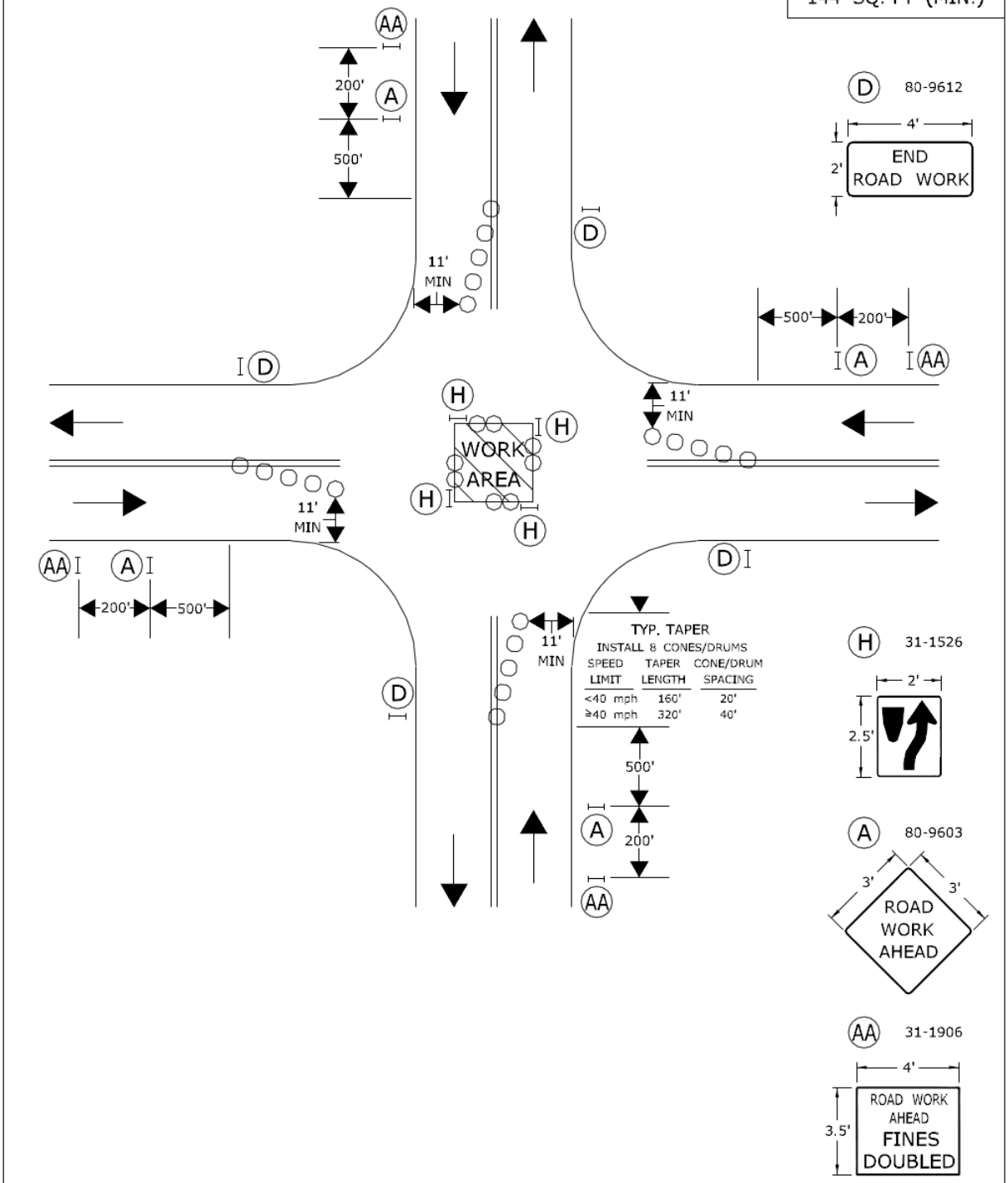
CONSTRUCTION TRAFFIC CONTROL PLAN
PLAN 16
SEE NOTES 1, 2, 4, 6, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 15:56:51-04'00'
PRINCIPAL ENGINEER

WORK IN MIDDLE OF ROADWAY AT INTERSECTION

SIGN FACE
144 SQ. FT (MIN.)



TRAFFIC CONE **OR** TRAFFIC DRUM
OPTIONAL TRAFFIC DRUM PORTABLE SIGN SUPPORT
HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

PLAN 17

SEE NOTES 1, 2, 4, 6, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 15:57:16-04'00'
PRINCIPAL ENGINEER

Article 9.71.05 – Basis of Payment is supplemented by the following:

The temporary relocation of signs and supports, and the furnishing, installation and removal of any temporary supports shall be paid for under the item "Maintenance and Protection of Traffic". Temporary overhead sign supports and foundations shall be paid for under the appropriate item(s).

The cost of furnishing, installing, and removing the material for the 4H:1V traversable slope shall be paid for under the item "Maintenance and Protection of Traffic."

ITEM #0999002A – DISPOSAL OF BUILDINGS

Article 9.99.01 - Description:

Work under this item shall include all activities related to the deconstruction/demolition and recycling/disposal of structures as detailed in this specification. Upon award of the Contract, the Contractor shall accept title and ownership of such structures as detailed herein, as well as all risk of loss and any and all liability in connection therewith. The Contractor shall not rent or otherwise use such structures without written permission from the Engineer.

The Commissioner reserves the right to delete from the contract the removal of any of the buildings listed in the contract documents.

The work shall be performed by an experienced firm that has successfully completed deconstruction/demolition work similar to that indicated herein. Such firm shall be Registered for Demolition Business by the Department of Emergency Services and Public Protection (CTDESPP) in accordance with CGS 29-402, and shall perform work under the supervision of a competent person as defined under OSHA 29 CFR 1926.850 - Demolition. In addition, employees performing on-site deconstruction/demolition related activity shall have attended an OSHA 10-hour Occupational Safety and Health Training Course in Construction Safety & Health, or equivalent.

The State does not engage to protect any of the buildings against damage, in any form including loss of fixtures or equipment, or vandalism in the period between the bidder's inspection of the building and the time such building is formally released to him as described herein. The Contractor shall take this into account in placing his bid.

The Contractor shall not perform any deconstruction/demolition work until such time that all applicable hazardous material abatement has been completed, as detailed in Items 0020801A – Asbestos Abatement, 0020902A – Lead Compliance for Demolition and/or 0101143A – Handling and Disposal of Regulated Items.

All activities shall be performed in accordance with the State of Connecticut Demolition Code (CGS 29-401 through 415), the Connecticut State Building Code including Supplements and Amendments, OSHA Demolition Standard (29 CFR 1926.850), CTDEEP Solid Waste Management Standards (22a-209-1 through 13), CTDEEP Air Regulations (22a-174-1 through 36), CTDPH Public Health Code Regulations and Technical Standards for Subsurface Sewage Disposal Systems (19-13-B100a, B103 & B104), OSHA Construction Standards (29 CFR 1926), EPA Clean Air Act (CAA) National Ambient Air Quality Standards (NAAQS), ANSI A10.6-1990 – Safety Requirements for Demolition, NFPA 241-1993 – Safeguarding Construction, Alteration and Demolition Operations, and the State of Connecticut Office of Policy and Management Establishment of High Performance Building Construction Standards for State-Funded Buildings (16a-38k-1 through 7).

The Engineer will supply the Contractor with utility service disconnect notices and/or historical reviews from the State Historical Preservation Office, as applicable. Should such disconnect notices not be available, the Contractor shall arrange for the discontinuance of all utility services and obtain the necessary documentation from the utility provider.

Article 9.99.02 - Materials:

Sheeting for covering excavated materials and/or construction debris determined to be contaminated shall be polyethylene sheet having a minimum thickness of 6 mils.

Sedimentation control bales (Hay bales) shall conform to the requirements of Article 2.18.

Sedimentation Control System (Geotextile silt fencing) shall conform to the requirements of Article 2.19.

Granular Fill shall conform to the requirements of Article 2.13.

Article 9.99.03 - Construction Methods:

(1) Pre-Demolition Submittals and Permits:

(a) The Contractor shall, in accordance with CGS 29-406, apply for and obtain from the local building department, demolition permits for each structure to be deconstructed/demolished/recycled/disposed of. The Contractor shall pay all associated fees. The Contractor is also hereby notified that the local authority may impose a waiting period of up to one hundred-eighty (180) days before granting any demolition permit. It is the Contractor's responsibility to schedule activities to accommodate for such waiting periods and these waiting periods will not be allowed as the basis of delay claims by the Contractor.

(b) For each structure to be deconstructed/demolished, if an CTDPH Asbestos Abatement Notification Form was not submitted to the CTDPH and Notification for Demolition & Renovation was not submitted to EPA, the Contractor shall submit both forms not less than 10 business days prior to the commencement of deconstruction/demolition activities in accordance with CTDPH 19a-332a-3 & EPA 40 CFR 61.145 (b). The Contractor shall pay all associated fees.

(c) In accordance with CGS 29-407, prior to commencing deconstruction/demolition activity, Contractor shall notify each adjoining property owner by certified mail that such deconstruction/demolition operations are planned.

(d) In accordance with CGS 4b-64, for structures that are more than fifty years old, the Contractor shall post a sign stating the intent to demolish the structures in a conspicuous place on the property not less than 30 days before the demolition. The Contractor also shall publish notice of intent to demolish such structures three times in a newspaper of

general circulation in the municipality in which the structures are located not more than 120 days and not less than 30 days prior to deconstruction/demolition.

(e) At least fifteen (15) working days prior to the start of any deconstruction/demolition work, the Contractor shall submit the following to the Engineer for review and approval:

1. A copy of the Contractors CTDESPP Registration for Demolition Business
2. A copy of the approved demolition permit(s)
3. A copy of the EPA & CTDPH Demolition/Notification Forms (as applicable)
4. A copy of the letters to adjoining property owners
5. Copies of utility disconnect letters
6. Copies of on-site employee OSHA 10-hour Construction Safety & Health training certificates, or equivalent
7. Proposed protective/safety measures to be implemented with regards to personnel protective equipment (PPE) for employees as well as protection of adjacent properties, subsurface structural, electrical or mechanical equipment, etc.
8. Proposed dust control measures
9. Proposed demolition C&D bulky waste disposal facility
10. Proposed steel/scrap metal recycling facility
11. Proposed concrete, brick, stone batch processing/recycling facility
12. Proposed bituminous disposal/recycling facility
13. Any other proposed C&D waste stream recycling facility
14. Proposed septage waste facility (as applicable)
15. Certification from a licensed exterminator that the structures are free from rodent and insect infestations (as applicable)
16. A copy of the CTDEEP Nuisance Wildlife Control Operator license (as applicable)
17. Copies of the Site Postings and Legal Notices Published pursuant to CGS 4b-64 (as applicable)
18. Proposed Construction Waste Management Plan (CWMP)

(f) If, in lieu of deconstructing/demolishing a building, the Contractor intends to move a building off of the site or to have it moved, the Contractor shall submit to the Engineer at least fifteen (15) working days in advance of the move the proposed method of operation, proposed future location of the building, and documentation of permission to relocate the building, including all required permits from the municipality and/or the State.

(2) Disposal of Buildings Provisions:

The Contractor shall completely deconstruct/demolish the structures, and remove/recycle/dispose of the demolition debris. Furthermore, the Contractor shall backfill the foundation and subgrade areas, abandon utilities (including public water service and public sewer service), and properly abandon septic tank systems as detailed below or as directed by the Engineer.

Cold Storage Building, Putnam Maintenance Facility, Brookfield, Connecticut

The property consists of a one-story on slab metal building used for cold storage at the Putnam Maintenance Facility. There were no utilities, including electric, gas, telephone, and municipal water source, connected to the building. No fuel oil aboveground storage tanks (AST) or underground storage tanks (UST) were identified in the subject area.

Main Building, Putnam Maintenance Facility, Brookfield, Connecticut

The property consists of a one-story on slab brick garage maintenance building at the Putnam Maintenance Facility, along with an associated motor fuel island and various fuel/waste aboveground and underground storage tanks. Utilities, including electric, gas, telephone, municipal water source and municipal sewer service were connected to the building. Fuel/waste oil aboveground storage tanks (AST) and underground storage tanks (UST) and oil water separators were identified in the subject area, as were hydraulic lifts/floor drains.

The Contractor shall provide adequate safety measures and suitable protection for the public. This shall include, but not be limited to, erecting a fence or barricade not less than 8 feet high, along the street line the entire length of the structure, with each end returning back to the building prior to starting deconstruction/demolition in accordance with CGS 29-408.

The Contractor shall erect and maintain a sidewalk shed meeting the requirements of CGS 29-409 for structures that are within 6 feet of a street line or an area used as a public way, 12 feet or more in height, or when the distance between the street line or public area and such structures is more than 6 feet but less than ½ the total height of the structures to be deconstructed/demolished.

The Contractor shall retain the services of a licensed exterminator to determine the extent of rodent and insect infestation and if found, retain the exterminator to rid the structure of rodent and insect infestation. Any nuisance wildlife shall be removed by a CTDEEP licensed Nuisance Wildlife Control Operator (NWCO), retained by the Contractor, in accordance with CGS 26-47, prior to structure deconstruction/demolition.

The Contractor shall prevent damage to any existing utilities that are to remain in service during deconstruction/demolition. The Contractor shall not interrupt existing utilities serving adjacent facilities, except when authorized in writing by authorities having jurisdiction and the Engineer.

Use of explosives or blasting for deconstruction/demolition purposes will not be permitted.

No burning or flame/torch cutting will be permitted.

Any items listed in the Contract to be salvaged shall be removed in accordance with Item #006399A – Architectural Salvage.

Any items not designated for salvage in the documents that are of salvageable value to the Contractor may be removed as work progresses. The Contractor shall transport its salvaged items from site as they are removed. Storage or sale of such items will not be permitted on site. No requests for additional time will be considered based on delays caused by the Contractor's salvage work.

The Contractor shall use the methods of deconstruction/demolition required to complete the work in accordance with all codes, ordinances and requirements of governing authorities. Deconstruction/demolition practices shall be acceptable to the Engineer, shall assure the safety of persons, equipment and structures which are to remain, and shall provide adequate protection of the environment. The Contractor shall schedule demolition activities to minimize delays, storage of debris, and construction traffic on-site.

Deconstruction/demolition shall proceed in a systematic manner, from top of structures to ground. The Contractor shall complete demolition work above each floor or tier before disturbing supporting members on lower levels. Structural framing members shall be removed and lowered to ground by means of hoists or other suitable methods. Deconstruction/demolition equipment shall be located throughout the site/structure and shall remove materials so as not to impose excessive loads on supporting walls, floors and framing. Walls fronting on streets that will remain open shall be demolished inward, toward the middle of the building. Load bearing walls fronting on streets, shall be razed one story at a time. All floors above the third floor shall be demolished with the use of adequate chutes. No storage of rubble on the upper floors of any building or on the site shall be allowed. Concrete, masonry and stone walls shall be demolished in small sections.

The Contractor shall remove the structures to the top of the foundation and shall break up and remove the slab floor and/or foundation of the structures to a minimum of 24 inches below existing grade or as directed by the Engineer. The Contractor shall also break up any remaining (>24" deep) below grade concrete, brick or stone foundation materials and ensure that proper water drainage can be maintained through the foundation or floor slab following break-up. Any floor drain piping within the floor slabs shall be removed separately for disposal.

If hazardous materials are encountered during demolition operations, the Contractor shall immediately notify the Engineer. The Contractor shall also comply with applicable laws and regulations regarding removal, handling, disposal, and protection against exposure and environmental pollution.

Deconstruction/demolition operations and removal of debris shall not interfere with roads, streets, walks, and other adjacent occupied and used facilities. Shoring, bracing, barricades, fencing and other devices shall be used as necessary to protect adjacent properties and the public. Damage to adjacent facilities caused by demolition operations shall be promptly repaired. The Contractor shall not close or obstruct streets, walks, or other occupied or used facilities without permission from the Engineer and local authorities.

The Contractor shall implement a fugitive dust suppression program in accordance with the Contract to prevent the off-site migration of particulate matter and/or dust resulting from demolition activities. It shall be the Contractor's responsibility to supervise fugitive dust control measures and to monitor airborne particulate matter. The Contractor shall employ reasonable fugitive dust suppression techniques and shall visually observe the amounts of particulate and/or fugitive dust generated.

If the control of fugitive dust and/or particulate matter is not acceptable to the Engineer, the Contractor shall implement corrective measures, including using water or calcium chloride for dust control, temporary enclosures, and other methods to limit and control dust and dirt migration. The contractor shall not create hazardous or objectionable conditions, such as ice, flooding, water runoff and pollution when using water for dust control. Calcium Chloride for dust control shall conform to the requirements of Article 9.42. Water for dust control shall conform to the requirements of Article 9.43.

The Engineer will conduct ambient air monitoring for contaminants such as total lead, total dust, total fibers, silica, microbial spores, etc. for comparison to applicable standards. If any standard is exceeded, Contractor shall immediately cease operations and modify the engineering controls being used to maintain levels below the applicable standard.

Except as otherwise specified, the Contractor shall break up, demolish and remove from site for disposal/recycling/reuse:

1. All above ground building structures
2. All surface debris, brick, stone, concrete, walks and curbs
3. All existing bituminous and concrete paved areas
4. All structures, piers, tunnels, footings and foundations to a minimum depth of 24 inches below existing grade or below final grade, whichever depth is lower
5. All slabs on-grade or floors of structures without basements
6. All floor construction over basements, regardless of elevation
7. All apparatus and debris from within basements
8. All miscellaneous structures, fences and debris to produce a clean site

Basement floors may remain if located a minimum depth of 24 inches below grade; however, they shall be broken up sufficiently to permit drainage (pieces not greater than 48" in any direction).

Accumulated debris, rubbish, wood, plaster, roofing, wallboard, and other materials resulting from deconstruction/demolition and related operations shall be removed from the site daily as generated.

Land clearing shall be in accordance with Article 2.01. Land clearing debris generated during the demolition process shall be managed for beneficial reuse in accordance with the CTDEEP Brush & Stump Management Guidelines by companies registered under the CTDEEP Recycling

General Permit. The Contractor shall coordinate with the Engineer as to whether any chipping of untreated wood can be reused on-site or must be managed off site.

Steel and scrap metal generated during the demolition process shall be recycled as scrap metal at an approved scrap metal recycling facility. Aboveground and underground storage tanks (AST's/UST's) shall be cleaned prior to recycling. Disposal of any contents of the AST's/UST's shall be in accordance with Item 0101143A.

Materials that have not been characterized as hazardous shall be recycled off site or disposed of at a landfill. Transport materials removed from demolished structures and dispose/recycle off site as C&D solid waste in accordance with the CTDEEP solid waste management standards. The Contractor shall recycle as much C&D solid waste as practical, following waste management guidelines such as the US Green Building Council (USGBC) Leadership in Energy & Environmental Design (LEED) Green Building Rating System, in cases where it reduces the overall project costs, does not violate applicable regulations or restrictions, or contributes to compliance with the CTOPM High Performance Building Construction Standards. Burning of combustible materials from demolished structures shall not be permitted on site.

The Contractor shall dispose or recycle materials off-site in accordance with the Specifications and all Federal, State and local regulations. A copy of the shipping paper for each load of material shipped off-site for disposal/recycling, including the weight of the load as measured at the disposal/recycling facility shall be returned to the Engineer.

In accordance with CGS 29-413, the Contractor shall not allow any basement, cellar, hole or similar structure to remain uncovered or opened as a result of deconstruction/demolition activity.

The foundation and subgrade areas (e.g. basement) shall be backfilled to grade with surplus suitable excavated "clean fill" materials (unpainted brick, stone, concrete) from the project and graded with clean native soil. Any additional material required to bring the subsurface area to grade shall be granular fill in accordance with Article 2.13. Prior to placement of fill materials, areas to be filled shall be free of standing water, frost, frozen material, trash and debris. Construction debris, excluding clean fill, shall not be used as fill within the project limits and shall be properly disposed of in accordance with all regulations. After fill placement and compaction, the Contractor shall grade surface to meet adjacent contours and provide flow to surface drainage structures. Grading shall not create any depressions that can retain water, create any diversions to surface flow, or block the intended flow of surface water.

(3) Construction Waste Management:

In accordance with Section 16a-38k-4(d)(5) of the State of Connecticut Office of Policy and Management's Establishment of High Performance Building Construction Standards for State-Funded Buildings, and in accordance with guidelines such as the US Green Building Council (USGBC) Leadership in Energy & Environmental Design (LEED) Green Building Rating System, the Contractor shall divert as much non-hazardous construction and demolition (C&D) waste from disposal in landfill and incinerators as practical. The minimum acceptable level of

recycling and/or reuse/salvaging shall be at least 75% by weight of the non-hazardous C&D waste to be generated by the deconstruction/demolition process.

Contractor shall prepare, and submit to the Engineer for approval, a proposed Construction Waste Management Plan (CWMP) which will, at a minimum:

- Identify the types of materials to be diverted from landfill disposal and incineration
- Identify whether the materials will be sorted on-site or co-mingled
- Identify the proposed recycling facilities to be used for each type of materials to be diverted
- Project the total weight, by type, of the C&D materials to be recycled/salvaged/reused as well as disposed of in landfill, and then provide the estimated recycling rate (75% by wt. minimum).
- Specify what records/waste shipping papers/etc. the Contractor will maintain and submit to the Engineer as documentation of the types and amounts of C&D materials recycled/reused/landfilled and the actual recycling rate achieved.

The proposed CWMP and actual implementation shall divert a minimum of 75% by weight of non-hazardous C&D debris from disposal in landfills and incinerators, as well as redirect recyclable recovered resources back to the manufacturing process and/or appropriate sites. Note that excavated soil and land-clearing debris do not count toward the 75% calculation; however, diversion may include donation of materials to charitable organizations and salvage/reuse of materials on site.

Examples of the types of materials to be included in the CWMP include, but are not limited to:

1. Steel/Scrap Metal
2. Clean Concrete
3. Clean Brick
4. Cured Asphalt
5. Asphalt Roofing Products
6. Clean Wood
7. Acoustical Tile
8. Clean Gypsum Wallboard
9. Carpet
10. Porcelin Fixtures
11. Furniture & Furnishings

Identification of suitable haulers and recyclers to handle the designated materials shall be the responsibility of the Contractor.

Contractor shall maintain detailed records, by material type and weight, in order to track all materials during the project that are diverted from disposal in landfills and incinerators, redirected (recyclable recovered resources) back to the manufacturing process, and/or salvaged/reused at the project site, as well as those ultimately disposed of in landfills, and provide the Engineer such records, along with the calculated actual recycling rate.

(4) Sanitary Sewer Line Capping:

For sites connected to sanitary sewer, the Contractor shall cap all connections to sanitary sewer lines at the property line and shall perform this work under the supervision and approval of the Engineer and the Sewer Authority having jurisdiction of the property. All sewer lines shall be capped using a method acceptable to the Sewer Authority including the use of vitrified clay, concrete or cast iron disk, placed in the hub and the entire end sealed or encased in concrete. The Contractor shall coordinate its activities with the representative of the Sewer Authority and have such representative inspect and approve of the sewer line cap. Where excavations are required in the street for the purpose of capping sewer lines, the Contractor shall backfill and repair the affected street area in a manner acceptable to the Engineer. Any damage to sewer laterals or other sewer lines that are to remain in service shall be repaired by the Contractor at its own expense.

(5) Septic System Abandonment:

Septic tanks and hollow leaching structures shall be properly abandoned by the Contractor in accordance with the Connecticut Public Health Code Technical Standard for Septic Tank Abandonment 19-13-B103 V. A. 7. Abandonment shall be performed in such a manner as to eliminate the danger of the structures inadvertently collapsing. The chambers shall be emptied of all septage wastes. The structures shall be filled with clean sand or gravel, or the structures shall be crushed and the area backfilled.

(6) Post-Demolition Submittals:

The Contractor shall provide the Engineer, within 30 days of completion of the demolition work, a compliance package; which shall include, but not be limited to, the following:

1. Shipping papers from the CTDEEP solid waste disposal facility indicating receipt and acceptance of C&D solid waste demolition debris, which clearly indicates the weight of C&D solid waste disposed of and the name/location of the disposal facility.
2. Shipping papers from the approved scrap metal recycling facility indicating receipt and acceptance of scrap metal debris, which clearly indicates the weight of scrap metal recycled and the name/location of the recycling facility.
3. Shipping papers from the approved concrete, brick, stone, asphalt shingle, etc. batch processing/recycling facilities indicating receipt and acceptance of the recycled debris, which clearly indicates the type/weight of the materials recycled and the name/location of the recycling facility.
4. Calculations on the weight of each type of debris reused on-site as clean-fill, otherwise reused on-site, or elsewhere recovered and diverted from landfill.
5. Calculated actual C&D waste recycling/reuse rate, on a percent by weight basis.
6. If the Contractor does not achieve the specified requirement of diverting at least 75% by weight of the non-hazardous C&D demolition waste from landfill/incineration, the

Contractor shall submit written documentation detailing its good faith efforts that were made to satisfy the requirement.

Article 9.99.04 - Method of Measurement: is supplemented with the following:

The Contractor shall submit a lump sum bid price for the disposal of all buildings on the project included with the proposal. The lump sum bid price shall also include all other related necessary work and material associated with the deconstruction/demolition and recycling/reuse/disposal of the structures, such as permits, excavation, recycling, disposal, backfill, saw cutting, dust suppression, septic tank abandonment, water and sewer line capping, paving, sedimentation control system, granular fill, fencing etc.

Article 9.99.05 - Basis of Payment: is supplemented with the following:

The work will be paid by the State or paid for by the Contractor at the contract lump sum for the "Disposal of Buildings" as adjusted in accordance with the provisions of the above paragraph, which price shall include all materials, equipment, tools, labor and work incidental thereto.

The Contract lump sum shall also include all other related necessary work and material associated with the deconstruction/demolition and recycling/reuse/disposal of the structures, such as permits, excavation, recycling, disposal, backfill, saw cutting, dust suppression, septic tank abandonment, water and sewer line capping, paving, sedimentation control system, granular fill, fencing, etc.

Failure of the Contractor at the completion of all contract work to have met the specified requirement for diverting C&D demolition waste from landfill/incineration will result in the reduction in contract payments to the Contractor of 5% of the total lump sum bid for Item 0999001A, unless the Contractor can adequately document or substantiate its good faith efforts made to meet the required percentage to the satisfaction of the Engineer.

Final payment will not be made until all post-demolition submittals have been provided to the Engineer. Once completed documents have been received in their entirety, the Engineer will review and make the final payment to the Contractor.

Pay Item	Pay Unit
Disposal of Buildings	Lump Sum

END OF SECTION

ITEM #1301082A – 8” DUCTILE IRON PIPE (WATER MAIN)

ITEM #1301083A – 10” DUCTILE IRON PIPE (WATER MAIN)

Description:
This item shall consist of furnishing all labor, materials, tools and equipment necessary to install and test the following, as noted on the plans or as directed by the Engineer:

1. 8” Ductile Iron fire service from the 12” water main to a point 5 feet from the outside of the foundation wall.
2. 10” Ductile Iron water service will tap from the 12” water main to a point 15 feet from the outside of the building. The 10” Ductile Iron fire service will tap from the 10” water service line.

This work includes furnishing and installing the ductile iron pipe, fittings, valves, gate boxes, hydrants, insulation, thrust blocking and joint restraints as shown on the plans and specified herein. Disinfection, pressure testing, and temporary support of utilities is also included as part of this item.

Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

1. Evidence that the subcontractor installing the water service connections and related work possess proper state licensing and be approved by the Water Pollution Control Authority Town of Putnam prior to performance of the work.
2. Product Data in the form of manufacturer's technical data, specifications, and installation instructions for pipe, valves, fittings, and couplings. The Water Pollution Control Authority Town of Putnam will be permitted to review all “approved equal” products.
3. Submit Hydrostatic Test Reports, Purging and Disinfecting Reports.

Quality Assurance:
Materials and installation of the water main shall be in accordance with the Water Pollution Control Authority Town of Putnam and these Specifications. Comply with NSF 61, "Drinking Water System Components-Health Effects," for materials for potable water. Provide listing/approval stamp, label, or other marking on piping and specialties made to specified standards.

Utility Coordination:
Coordinate water service connection components furnished by the Water Pollution Control Authority Town of Putnam:

1. Coordinate installation and connection of exterior and underground utilities and services.
2. Comply with requirements of authorities having jurisdiction and utility company providing water and other services.
3. The Water Pollution Control Authority Town of Putnam will install the wet tap of the 8-

inch and 10-inch water main located in Putnam. The contractor shall provide all excavation, bedding and backfill required as included in the work of the water main installation.

4. A charge of $xxx shall be included in the contract bid price for the service connection to the facilities by the utility company. All contractors will include the above amount for utility service charges in the Contract Bid Price. If it is determined that different charges apply, the Contractor's bid will be adjusted to reflect the differential by construction order, provided that the Contractor provides all applicable written billing documentation. The Contractor will be compensated only for the difference between the billed amount and the estimated amount. No additional Contractor markup will be allowed.

   All bidders will include the above amounts in Item No. 1700001A – Service Connections (Estimated Cost) along with costs for work by other utilities.

5. The Contractor shall call "Call Before You Dig!" at (800) 922-4455 before any excavation takes place. Contractor shall coordinate excavation with paving operation.

Material:

General: All materials shall conform to the Water Pollution Control Authority Town of Putnam specifications.

Ductile Iron Pipe:

Pipe for water mains shall be ductile iron, meeting the requirements of ANSI/AWWA C151/A21.51 standards. Acceptable Manufacturers include: U.S. Pipe, Griffin Pipe, and Atlantic States Pipe.

1. Pipe thickness shall meet all requirements of AWWA C150/A21.50 – Class 52.
2. All piping shall be cement-lined (double-thickness) with bituminous seal coat inside and out in accordance with AWWA C104/A21.4.
3. All pipe joints (unless otherwise specified on the plans or these specifications), shall be push-on joints, employing a single rubber gasket, to affect a watertight seal. All joints shall conform to the applicable requirements of ANSI/AWWA C111/A21.11-07 or the latest revision thereof. The push-on joint shall be the "Tyton" joint pipe, as manufactured by U.S. Pipe or equivalent.
4. Rubber gasket joints shall conform to AWWA C111/A21.11.
5. All interior applied coatings, field lubricants used to make joints, etc. shall meet NSF Standard 61.
6. To join plain ends of cast iron or ductile iron pipes in non-thrust restraint zones, use a ductile-iron, epoxy coated coupling with stainless steel nuts and bolts. Acceptable manufacturers / products include: Smith Blair 441, or an approved equal.

Flanged Fittings:

Fittings for water mains shall be the cast iron or ductile iron to comply with ANSI/AWWA C110/A2 1.20 and 125 # ANSI B16.1 faced and drilled.

1. Acceptable manufacturers include Union/Tyler, U.S. Pipe, and Napac.
2. Fittings shall be manufactured in the United States of America.

3. Fittings include but may not be limited to all tees, bends, reducers, end caps, and plugs.
4. Fittings shall have pressure rating at least 350 PSI, or an equivalent pressure rating to that of the pipe, whichever is greater.
5. All fittings shall be cement lined (double thickness), with seal coat inside and out. The exterior coating shall be red primer.

Mechanical Joint (MJ) Fittings:
Cast iron or ductile iron class 53 compact fittings to comply with ANSI/AWWA C153/A2 1.53 ANSI/AWWA C111/A21.11. Fittings shall be manufactured in North America. All fittings shall be cement lined and seal coated in accordance with ANSI/AWWA C104/A21.4. The exterior coating shall be seal coated. Acceptable manufacturers include Tyler Union, and US Pipe.

Thrust Restraint:
1. Primary Thrust Restraint – Ductile Iron Pipelines:
    a. Restraint of Mechanical Joints: Wedge action type, high strength ductile iron per ASTM A536, Grade 65-45-12. All mechanical points to conform to ASNI/AWWA C111/A21.11, UL listed and FM approved. Wedge bolts shall be ductile iron with torque-actuated breakaway bolts.
        i. Mechanical joint restraint shall have a rated pressure of 350 PSI.
        ii. Acceptable manufacturers / products include EBBA Megalug 1100 Series, Ford Uni-Flange Series 1400, Wedge Action Retainer, and RomaGrip.
    b. Restraint of Push-On Joints:
        i. Push-on joint restraint shall have a rated pressure of 350 PSI.
        ii. Acceptable manufacturers/products include EBBA Series 1700 U.S. Pipe Field Lock Gaskets, or equal.
2. Thrust Blocks:
    a. Use pre-cast concrete thrust blocks of the size and shape indicated on the Contract plans. Pre-cast concrete blocks shall comply with Form 818 – Article M.08.02 – Item 2 "Concrete Building Brick for Catch Basins, Manholes, or Drop Inlets".

Couplings:
Couplings shall be ductile iron to meet or exceed ASTM A536, Grade 65-45-12. Gaskets shall comply with ASTM D2000. Bolts and nuts shall meet or exceed AWWA C111 and ASTM A242. Acceptable manufacturers/products include Ford Meter Box Series FC, JCM Industries No. 210 or No. 212, and Romac Model No. 501.

Gate Valves:
Use resilient seated, iron body, bronze mounted resilient wedge, "O-ring" seal, with mechanical joint ends and non-rising inside screw for underground valves, conforming to the requirements of AWWA C509.
1. Valves 12 inches and smaller shall be designed for a working pressure of 250 pounds per square inch.
2. Valves shall have a clear waterway equal to the full nominal diameter of the valve.
3. Valves shall open to the right.
4. Provide stationary rods for all valves.

5. Acceptable manufacturers/products include AVK, Clow, Mueller A2360 Series, Mueller T2360 Series (Tapping Valve), Kennedy, and American Flow Control Series 2500.

Gate Valve Boxes:
Use adjustable, two-piece, 5-1/4" diameter, cast iron slide-type gate box, complete with o-ring and drop lid. Drop lid shall be marked "Water."

1. Extension: 42-60-inch. If extension exceeds 50-inches, an extension rod and ring may be required by the Water Pollution Control Authority Town of Putnam.
2. Acceptable manufacturers/products include Tyler, QWP, Bibby, and Ste-Croix.

Butterfly Valves (Underground):
NRS butterfly valve or permanently lubricated meeting AWWA C504, with interior epoxy coating. Shafts shall be 18-8 Type 304 stainless steel. Shaft seals shall be O-ring type. Acceptable manufacturers/products include Clow 4500, Mueller, and Pratt 2FII.

Tapping Sleeve:
Iron body, mechanical joint ends comply with ANSI/AWWA Standard C111, with asphalt tar varnish coatings, 200 psig maximum working pressure. Outlet Flange dimensions and drilling that comply with ANSI B16.1, class 125 and with MSS SP-60. Acceptable Valves manufacturers/products include Mueller H615, or equal.

Saddle:
Ductile iron body with stainless steel bands and hardware. Acceptable manufacturers/products include Smith Blair Style 317, or an approved equal.

Pipe Joint Protection:
Use stainless steel body with malleable iron lug repair clamps where indicated on the Contract plans or where directed by the Engineer, to protect pipe joints in close proximity to sanitary sewer manholes. Acceptable manufacturers/products include Smith Blair Style 226, or an approved equal.

Factory Prefabricated Piping System:
Factory prefabricated piping system includes interior carrier piping, insulation, heat tracing cable, and exterior piping system shall be assembled at the factory and shipped to the site in such a way as to minimize the number of field joints required. When installed, the exterior casing shall form a sealed water tight barrier to protect the insulation and heat tracing against submergence in a high ground water table.

Insulation:
The insulation shall be rigid polyurethane foam with the following characteristics: K Factor – 0.13, Density – 2 pcf, Closed Cell Content – 90 to 95%, in conformance with ASTM C-591 and MIL-I-24172, completely filling the annular space between the carrier pipe and the jacketing.

Rigid Foam Insulation:
Rigid Foam Insulation: Sizes and types indicated on the Contract plans or as directed by the Engineer to protect water mains from potential freezing conditions. Rigid foam insulation shall possess the following characteristics:

1. Rigid closed-cell, expanded polystyrene board.

2. 1.5-inch thick extruded board
3. Comply with FS-HH-I-524, Type II, Class B.
4. Compressive strength: 30 psi.
5. Water adsorption: 1.0 perm per inch maximum.
6. Thermal conductivity: (K-value at 75o F) – 0.2.

Conduit:
Manufacturer recommendation.

Casing:
The casing shall be high impact polyethylene (PE) made from a resin compound qualified as Type III, Category 5, Class C, Grade P23 or P34, as per ASTM D1248. No PVC casing pipe will be allowed. Alternative casing pipe shall be fiberglass reinforced thermosetting resin pipe in accordance with ASTM D2310. Casing pipe shall be 12 inch nominal diameter with a minimum wall thickness of 0.150 inches.

Polyethylene Encasement:
Polyethylene sheeting and tubing used for the external corrosion protection of buried ductile-iron pipe, fittings and appurtenances shall meet American Water Works Association ANSI-AWWA C105/A21.5-99(10) standards. The material shall be produced from a low density polyethylene with a density of 0.910 to 0.935 and a minimum thickness of .008 inches (8MIL) or if designated by the Company a high density cross laminated polyethylene with a high density of 0.940 to 0.960 and a minimum thickness of .004 inches or (4Mils).

Unless otherwise specified or approved, all material supplied shall be either as a continuous rolls, perforated at either 20 or 22 foot intervals. It shall be marked with the following information:

A.) Name of manufacturer
B.) ANSI/AWWA C015-A21.5
C.) 8 MIL LLDPE or 4 MIL CLHDPE
D.) Applicable range of nominal pipe diameter
E.) Warning – Corrosion Protection – Repair Any Damage

Each shipment shall contain certification that the material meets the minimum requirements specified by American Water Works Association Specification ANSI-AWWA C105/A21.5-99.

Underground Warning Tape:
Detectable warning tape shall be acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep. Warning tapes shall be solid blue film with continuously printed black-letter caption "CAUTION--WATER LINE BURIED BELOW", repeated at a maximum interval of 40-inches.

Trench Excavation:
Furnish materials and products required for safe and effective bracing and shoring of the trench excavation.

Bedding:
Comply with Form 818, Article M.03.01 - Item 2 (FINE AGGREGATE).

Disinfection and Flushing:
Provide all tools, power, materials, and chemicals necessary to disinfect, test, flush, and de-chlorinate the water main and appurtenances, in conformance with AWWA Standards C600 and C651 and Standards stated in Section 19-13-B102 of Regulations of Connecticut State Agencies.

Pressure Testing:
Provide all tools, materials, test plugs, caps, pumps, pipe connections, water meter, pressure gauges, and other equipment required to perform pressure and leakage testing in conformance with AWWA Standard C600 and NFPA-13 (for fire protection waterline).

The gauge used in the pressure and leakage testing apparatus shall be a minimum of 4-inches in diameter and pressure increments shall not exceed 2 P.S.I.

Construction Methods:
General:
Water main installation shall conform to the Water Pollution Control Authority Town of Putnam Standards and Specifications and AWWA Standard C600, latest revision. The following additions shall apply in regard to Construction Methods:

Handling and Distribution of Pipe, Fittings, and Valves:
The pipe, fitting, and valves shall be handled and protected during loading, transporting, and unloading operations in such manner as to avoid damage. Pipe, fittings, valves and hydrants shall be lowered carefully into the trench using a backhoe, a crane, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench nor shall they be permitted to roll against pipe already on the ground. Insofar as practicable, each piece of pipe shall be delivered and unloaded near the place where it is to be installed and readily inspected by the Engineer and where it will not interfere with excavation operations, traffic, or access by adjacent property owners. If this is not possible, the pipe, fittings and valves shall be stored in a safe area as close to the job site as possible. The Contractor is responsible for identifying a location for storage of pipe, fittings, valves, and excavated material. All damaged pipe, fittings, and valves will be rejected and such rejected pipe, fittings, and valves shall be removed from the site. In the event of slight damage to the coating or lining, the Engineer may permit the damage to re repaired at the site. Such repairs shall be made at the Contractor's expense.

Laying Ductile Iron Pipe:
All pipe installation shall conform to AWWA Standard C600, latest revision, unless otherwise modified by these Specifications.

1. Ductile iron pipe shall be laid to the minimum depths shown on the Contract plans unless otherwise directed. Where pipe is installed at less than the required cover, the Contractor shall install insulation. Where the pipeline crosses existing utilities, a vertical clearance of twelve inches (12") minimum shall be maintained, except for sanitary sewers and storm drains where at least eighteen inches (18") of vertical

clearance shall be maintained. The pipe between bell holes shall bear continuously on clean fill. If the Contractor excavates below the required limit, the trench bottom shall be brought to the required grade with an approved backfill of gravel, sand or crushed stone at the Contractor's expense. In laying pipe, the deflections shall not exceed 75% of the deflection given in AWWA Standard C600 latest revision. Ductile iron piping shall be wrapped in polyethylene.

2. All pipe fittings and valves shall be lowered carefully into the trench by means of mechanical equipment in such a manner as to prevent them from being damaged. The insides of all bells and outsides of spigots shall be wiped clean and dry and shall be free from oil or grease. During the laying of the pipe, extra care shall be taken to see that no dirt, debris, tools, clothing, or other illicit materials are allowed to be left in the pipeline.
3. After the pipe is laid in the trench, the spigot end shall be centered in the bell and forced home. Under no circumstances shall pipe be laid where there is water in the trench. The Contractor shall install and joint the pipe in accordance with the manufacturer's instructions. The joints shall be made continuous by the installation of metal wedges per the manufacturer's instructions.
4. When necessary to cut pipe in the field, the cutting shall be done such that neither the pipe nor the lining shall be damaged and such that a smooth, right angle to axis cut is made. A machine designed for this purpose shall be used for the cutting.
5. Terminate water-service piping at a point 5'-0" off of the foundation wall of buildings until building water piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building water piping systems when those systems are installed.
6. At all times when pipe laying is not actually in progress, the open ends of the pipe shall be closed by temporary watertight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed.

<u>Trench Excavation:</u>
Excavation and backfilling shall be performed as described herein and in accordance with Article 2.05.03 of Form 818.

Bank gravel shall be suitable material for backfilling trenches. Bank gravel shall conform to the requirements of Form 818, Article M.02.01-2.

Warning tape shall be placed approximately 2' above the pipe. The trenches shall be refilled in 6 inch layers at least to a level 12" above the top of the pipe with bank run gravel, compacted in accordance with the requirements below, each layer to be leveled and thoroughly compacted to the satisfaction of the Engineer and Water Pollution Control Authority Town of Putnam before the next layer is deposited. Backfilling shall be done in a manner which will prevent subsequent settlement and injury to the pipe.

Each layer of material shall be compacted by the use of vibratory compaction equipment or rollers or other means to achieve the required compaction. At such points as cannot be reached by mobile mechanical equipment, the materials shall be thoroughly compacted by the use of suitable power-driven tampers.

All backfill material shall be compacted to at least the specified percent maximum density as determined by ASTM D1557 Method C:

LOCATION	PERCENT MAXIMUM DENSITY
Below pipe centerline	95
Above pipe centerline (below unpaved surface)	92
Above pipe centerline (below paved surface)	95
Embankments	92
Below pipe in embankments	95
Below structures	95

Previously placed or new materials shall be moistened by sprinkling, if required to ensure proper bond and compaction. No compacting shall be done when the material is too wet, from wither rain or too great an application of water, to compact it properly; at such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compaction. The water content of the soil shall be adjusted by wetting or drying as may be necessary to obtain proper compaction.

Bedding:
Bedding materials shall comply with Form 818, Article M.03.01 - Item 2 (FINE AGGREGATE). Sand bedding material shall be placed under and around water mains and fittings for support and protection. Sand bedding material shall be placed in layers of not more than 6 inches in depth after compaction. The water main shall be installed in sand bedding material, with a thickness directly under the pipe of 6 inches and preshaped to a height of 10 percent of the total height of the pipe. After the pipe has been installed, the trench shall be backfilled with sand bedding material to a height of 12 inches above the top of the water main.

Temporary Support of Utilities:
The work involves the support of utilities during the excavation and construction of the proposed work. The Contractor shall notify the Engineer prior to the start of their work and shall be responsible for all coordination with the utility company. Temporary support of utilities shall meet the requirements of the respective utility company.

Cleaning and Inspection of Pipe, Fittings, and Valves:
The insides of pipes, fittings, and valves shall be thoroughly cleaned before installation and shall be kept clean until accepted in the completed work. Whenever the work is interrupted, all open ends of pipe shall be temporarily closed by water tight plugs. No trench water shall be permitted to enter the pipe. All pipe and special casting shall be carefully examined for defects and no pipe or special casting shall be laid which is known to be defective. If any such pipe or casting is discovered to be defective after placement, it shall be removed and replaced with a sound pipe or casting by the Contractor at its expense.

All underground pipe in fire services and all pipe before the meters in domestic services shall be pressure tested in the presence of the Engineer and MDC at a pressure of 150 pounds per square inch for domestic and 200 pounds per square inch for fire services.

Fire pressure tests may also require witnessing by the authority having jurisdiction.

Installation of Valves:
Valve boxes shall be set carefully, truly vertical, and accurately centered over the operating nut with the top set at roadway or existing ground surface grade.

Ductile iron Fittings:
Comply with AWWA Standard C600. Restrain mechanical joints at all fittings as described elsewhere in this specification.

Gate Valves (12 inches and smaller):
Comply with AWWA Standards C600, C500-Appendix A, and C509 Appendix A. Restrain mechanical joints at gate valves as described elsewhere in this specification.

Thrust Restraint:
Thrust Restraint – Ductile Iron Pipelines:

1. Install mechanical joint restraint on all ductile iron fittings and gate valves in strict compliance with manufacturer's instructions.
2. Install restraint harnesses or locking gaskets on push-on joints within thrust-restraint zones in strict compliance with manufacturer's instructions.
3. Use pre-cast concrete thrust blocks of the size and shape indicated on the Contract plans.
4. Place all thrust blocks firmly between the fitting and trench wall, in an alignment that coincides with the direction of thrust.

Pipe Joint Protection:
Furnish and install repair clamps where indicated on the Contract plans or directed by the Engineer. Install repair clamps in strict compliance with manufacturer's instructions.

Installation of Factory Prefabricated Piping System:
The factory prefabricated piping system shall be installed where shown on the plans in accordance with the manufacturer's instructions and under the supervision of the manufacturer's representative. Special care shall be taken to ensure that all field joints are assembled in such a manner as to maintain the exterior casing pipe watertight. Install conduit from heat tracing to electrical utility service at the Pumping Station (Sanitary Sewer).

Rigid Foam Insulation:
Contact the Engineer immediately for insulation instructions if field conditions warrant substandard cover. Furnish and install rigid foam insulation as directed by the Engineer.

Disinfection and Flushing:
Disinfection of new water mains shall be done in accordance with AWWA C651-latest edition. Chemicals used in the disinfection process shall be NSF or UL certified to NSF/ANSI Standard 60. Contractor shall pay particular attention to precautions against contamination. The interior of all pipe, fittings, and other accessories shall be kept as free as possible from dirt and foreign matter at all times. If, in the opinion of the Engineer, the pipe contains dirt that will not be removed during the flushing operation, the interior of the pipe shall be cleaned and swabbed, as necessary, with a bactericidal solution. Solutions for swabbing shall be mixed as follows:

1 lb. High-test Calcium Hypochlorite (65%-70%) to 7.5 Gallons Water.

The Contractor shall furnish all equipment and materials necessary to do the work of disinfection and flushing, and shall perform the work in accordance with the procedure outlined in the AWWA Standard for Disinfecting Water Mains, Designation C651 Section 4.4 using the continuous feed method. Thoroughly flush all pipelines prior to the disinfection process. Install a double check-valve between the test-water source and the new water distribution system. Provide other safety measures as may be required. Following the disinfection process, thoroughly flush all pipelines before sampling for tests. Following the flushing process, retrieve and convey test samples to a certified water testing laboratory. Water samples shall be analyzed for coliform bacteria, physical parameters, and VOC's. To pass, test results must reveal total coliform (TC) = 0 and heterotrophic plate count (HPC) = 0. If, the Engineer determines that the disinfection process failed, repeat the entire disinfection process to the satisfaction of the Engineer, at no cost to the State, and without extension of time for completion of the work. Dispose of all chlorinated test water in accordance with local, state, and federal regulations (which may require de-chlorination). Obtain all required discharge permits prior to start of the disinfection process.

Hydrostatic and Leakage Testing:
Following disinfection all new water pipe and appurtenances shall be subjected to hydrostatic pressure and leakage testing to ensure water tightness and integrity of construction in accordance with the most current applicable AWWA Standard C600. If manufacturer's instructions are more stringent than AWWA standards, water pipe shall be hydrostatic tested in accordance with manufacturer's instructions.

The test pressure shall be maintained for at least 2 hours, during which time the leakage shall not exceed the allowable leakage as tabulated in AWWA C600, Section 5.216 and NFPA-13. Hydrant valves shall be open during the hydrostatic tests. If hydrants or blow-offs are not available for releasing air, excavate at high points, tap the main, and install a plug for air release.

Prior to making the test, the Contractor shall submit for approval a schedule of its testing procedure with a description of methods and equipment he proposes to use. Test pressures shall be monitored by the use of an approved test gauge which shall be dead weight tested prior to testing. Test gauge shall have 1 pound increments and a 4-1/2 inch dial.

All visible leaks shall be made tight and, if the line does not meet the above leakage test, it shall be repaired and retested until the leakage requirement is met. The Contractor shall furnish all labor, equipment, and materials for testing. All valves and connections shall be made tight and shall operate properly before the work is accepted. All defective work shall be repaired or replaced at the expense of the Contractor.

All costs for performing the hydrostatic test, including pumps, gauges, and other work and materials required are included under this Item. The above hydrostatic test shall be conducted in the presence of the Engineer, utility company and the State Fire Marshal. The Town will provide, at no charge to the Contractor, the necessary water for this initial pressure and leakage tests. If this initial test fails, the Town will charge the Contractor for all subsequent required water. Install plug and backfill the excavation following successful completion of the test.

Method of Measurement:

The quantity to be paid for under ITEM # 1301082A 8” DUCTILE IRON PIPE and ITEM # 1301082A 10” DUCTILE IRON PIPE shall be the actual number of linear feet of new 8” and 10” ductile iron pipe furnished, installed and accepted as shown on the Contract Drawings and specified herein.

Basis for Payment:
ITEM #1301082A 8” DUCTILE IRON PIPE and ITEM # 1301082A 10” DUCTILE IRON PIPE shall be paid for at the Contract Unit price per linear foot of 8-inch ductile iron pipe and 10-inch ductile iron pipe complete in place, which price shall include all labor, materials, tools, equipment and work incidental thereto. Additionally, the lineal foot price shall include all gate valves, ball valves, rigid foam insulation, thrust blocking, fittings, and joint restraints and the coordination and connection of the new service to the existing service, including Town of Putnam, the Water Pollution Control Authority Town of Putnam and/or local water authority tap fees. Care and protection of existing pipes and utilities, and other structures; disposing of excess materials, dewatering, furnishing and placing sand and all other work shown or specified for furnishing, installing, disinfecting, flushing and testing the 8-inch ductile pipe and 10-inch ductile iron pipe as shown on the Contract Plans and specified herein is also included.

Pay Item	Pay Unit
8” Ductile Iron Pipe	l.f.
10” Ductile Iron Pipe	l.f.

ITEM #1301305A – 1 1/2" COPPER PIPE (TYPE K)

ITEM #1301307A – 2" COPPER PIPE (TYPE K)

Description:
Work under this item shall consist of furnishing all labor, materials, tools and equipment necessary to install the 2" and 1-½" copper service connection from the water main to a point 5 feet from the outside of the foundation wall, as shown on the plans. This includes furnishing and installing the 2" and 1-½" copper pipe, service saddle, corporation, curb stop and curb box, fittings, joint restraints, disinfection and testing as shown on the plans and specified herein. Also included are excavation and restoring turf as indicated on the plans to allow for installation of the 2" and 1-½"copper pipe.

Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

1. Evidence that the subcontractor installing the water service connections and related work shall possess proper state licensing and be approved by the Aquarion Water Company of Connecticut prior to performance of the work.
2. Product Data in the form of manufacturer's technical data, specifications, and installation instructions. The Aquarion Water Company of Connecticut will be permitted to review all "approved equal" products.
3. Submit Hydrostatic Test Reports, Purging and Disinfecting Reports.

Quality Assurance: Comply with requirements of the Aquarion Water Company of Connecticut, as outlined in their Water Service Standard Details Manual. Comply with NSF 61, "Drinking Water System Components-Health Effects," for materials for potable water. Provide listing/approval stamp, label, or other marking on piping and specialties made to specified standards.

Material:
Service piping: Water service lines shall be type "K", soft seamless copper tubing with no soldered joints underground, conforming to ASTM B88-76. Approved manufacturers include Halstead, Cambridge, Cerro, Mueller and Wolverine.

Service Saddles: Double strap service saddles shall have epoxy or nylon coated body and stainless steel nuts, bolts and double straps. Taps shall be CC (Mueller) thread unless otherwise noted. Approved manufacturers include Smith-Blair (#317), Romac (#202N), or Mueller.

Corporation Stops: Corporation stops shall be in accordance with ANSI/AWWA Standard C800 and ASTM B-62. The inlet shall have a standard AWWA corporation valve inlet thread (Mueller CC) and the outlet shall be a compression connection for copper tubing. Approved manufacturers include Mueller (B-25008 or H-15008), Ford, or McDonald.

Curb Stops: Curb stop valves shall be bronze-body and in accordance with ANSI/AWWA

Standard C800 and ASTM B-62. Both ends of curb stop valves shall be compression connections for copper service tubing. Approved manufacturers include Mueller (B-25209 or H-15209), Ford or McDonald.

Curb boxes: Curb boxes shall be iron-body with close fitting, dirt tight or screw type covers. The top of the cover shall be flush with the top of the box rim with the word "WATER" clearly marked. Curb boxes shall be extension type with 35" stationary rod. Approved manufacturers include Mueller (H-10314), Ford (domestic), or Clow (Canada).

Identification: Detectable warning tape shall be acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 3 inches wide and 4 mils thick. Warning tapes shall be solid blue film with continuously printed black-letter caption "CAUTION - WATER LINE BURIED BELOW."

Bedding: Gravel Bedding Material shall conform to the requirements of Form 818 Article M.02.01.

Construction Methods:
Piping: Install water-service piping and connect to water-supply in locations and pipe sizes indicated on the plans. Terminate water-service piping at a point 5 feet off of the building foundation. Terminate piping with caps, plugs, or flanges as required for piping material.

Trench Excavation: Trench excavation shall comply with the requirements of Form 818, Article 2.05.03.

Bedding: Placement of bedding material shall comply with Form 818, Article 6.51.03.

Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

Hydrostatic Tests: Test at not less than 1-1/2 times working pressure for 2 hours. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within above limits. Prepare reports for testing activities.

Disinfection and Flushing: Before any section of pipeline is put into service, it shall be thoroughly disinfected in accordance with the following:

1. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine. Isolate system or part thereof and allow to stand for 24 hours.
2. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
3. Following allowed standing time, flush system with clean, potable water until chlorine does not remain in water coming from system.
4. A sample of water from the section shall be collected for analysis by the Utility. No

section of the main shall be put into service without the approval of the Utility. Should the analysis be unsatisfactory, the section shall be re-disinfected and retested until a satisfactory analysis is obtained at no cost to the State, and without extension of time for completion of the work.

Method of Measurement:
This work will be measured for payment by the actual number of linear feet of 2" and 1-½" Copper Pipe (Type K) completed by the Contractor and accepted by the Engineer.

Basis for Payment:
This work shall be paid for at the contract unit price per linear foot for 2" and 1-½" Copper Pipe (Type K), complete and in place, which price shall include all labor, materials, tools, equipment and work incidental thereto. Additionally, the lineal foot price shall include fees associated with the Aquarion Water Company of Connecticut application for Water Service, the temporary termination of water-service piping at a point 5 feet off of the foundation wall of buildings until building water piping systems are installed, and care and protection of existing pipes and utilities. Also, excavation, disposing of excess materials, dewatering, furnishing and placing bedding material, restoring turf and all other work shown or specified for furnishing, installing, disinfecting, flushing and testing the 2" and 1-½" copper pipe as shown on the plans and specified herein is also included.

For item above, where rock is encountered, the additional efforts to excavate will be paid as "Rock in Trench Excavation 0'-10' Deep", in accordance with Article 2.05.05, Form 818.

Pay Item	Pay Unit
2" Copper Pipe (Type K)	LF
1-½" Copper Pipe (Type K)	LF

ITEM #1504010A – TEMPORARY SUPPORT OF UTILITIES

Description:
Work under this item shall consist of designing, furnishing, placing and subsequently removing temporary supports and protection shields which will be necessary to protect and/or stabilize the existing utilities encountered during the construction of the proposed work shown on the Contract Drawings, including any affected utilities, as shown on the plans.

The work pertaining to the temporary support of utility pipes/facilities involves the support and prevention of damages which are possible during the excavation and construction of the proposed work show on the Contract Drawings.

The Contractor is advised that no service interruption resulting from his operations will be allowed. Caution shall be exercised during all stages of construction in order to preserve the existing utilities. A Utility Company representative shall be present at the installation of the temporary supports.

The Contractor shall notify the Engineer prior to the start of his work and shall be responsible for all coordination with the Utility Company. The Contractor shall allow the Engineer and Utility Company representatives complete access to the work.

Temporary support of utilities shall meet the requirements of the respective utility company.

Contractors are cautioned that it is their responsibility to verify locations, conditions and field dimensions of all existing features, as actual conditions may differ from information indicated on the plans or contained elsewhere in these specifications.

Material:
The materials for this work shall be of satisfactory quality for the purpose intended and shall be approved by the Engineer. The material shall be intended for use in structures and shall be sound and capable of safely carrying the specified loads.

The materials for this work shall conform to the following requirements:
1. Structural steel shall be AASHTO M270, Grade 248.
2. Bolts shall be ASTM A325.
3. Threaded rods shall be ASTM A307.
4. Concrete shall be Class “C”.
5. All timber and lumber used shall be sound and free of any defects that may impair its strength.

Construction Methods:
The Contractor shall prepare working drawings and computations showing his proposed method of support and protection for each utility to be supported and protected. Preparation of working drawings and computations shall conform to the requirements of Subarticle 1.20-1.05.02 of Form 818.

The Contractor shall prepare working drawings and computations showing his proposed method

of support and protection. The support shall safely carry all utility dead loads and any imposed loadings under all possible construction conditions. The utility protection shields shall safely carry any imposed loadings under all possible construction conditions. Said supports and protections shall be constructed in a manner that will not interfere with the removal of existing drainage pipes or structure or proposed drainage system installation.

The design shall be submitted to the utility representatives for review and approval. Following Utility Company approval, the design shall be submitted to the Engineer for review in accordance with Article 1.20-1.05.02 of Form 818 at least three (3) weeks prior to the beginning of construction. No work will be allowed in the vicinity of any utility until the Contractor receives approval of his support method from the utility representative and the Engineer.

The design calculations shall include, but not be limited to the following:

1. Material designations and material lists.
2. Allowable loads or stresses for all structural members and components.
3. Design loads and stresses for all structural members and components.
4. References for all design equations.

The working drawings shall include, but not be limited to the following:

1. Layout plan showing the location, limits, spacing, etc. of all substructural members of the temporary support.
2. Member sizes and details of their connections.
3. Material designations and material lists.
4. Procedures outlining the proposed sequence of operations to be followed when installing and removing the temporary supports.

The working drawings and design computations shall be sealed by a Professional Engineer licensed in the State of Connecticut, who shall be available for consultation in interpreting his computations and drawings, and in the resolution of any problems which may occur during the performance of the work. Please note that each working drawing must be sealed.

The furnishing of calculations and working drawings shall not serve to relieve the Contractor of any part of his responsibility for the safety of the work or for the successful completion of the work.

The Contractor shall use every effort to protect all utilities from damage of any nature that might result from carelessness or negligence in his operations. He shall be held solely and strictly responsible for any damage resulting from such carelessness and negligence.

A periodic inspection of the temporary utility support and protection shall be performed by the Contractor, as directed by the Engineer.

The Contractor shall support and maintain the existing utilities until such time as the new work has been installed and all trenches backfilled to grade above the utilities.

When the temporary utility support and protection systems are no longer required, they shall be removed from the site by the Contractor.

Method of Measurement:
This work, being paid for on a lump sum basis, will not be measured for payment.

Basis for Payment:
The work will be paid for at the contract lump sum price for "Temporary Support of Utilities" which price and payment shall constitute full compensation for coordination with utility companies and other authorities having jurisdiction, designing and detailing the supports and protection shields, furnishing, installing, periodic inspection, placing and forming flowable fill, and removing supports and protection shields, and all materials, equipment, tools and labor incidental thereto.

Pay Item	Pay Unit
Temporary Support of Utilities	Lump Sum

ITEM #1600002A – FUEL ADJUSTMENT COST

Description: This Item is included in the Contract to reimburse the Contractor for purchasing gasoline, diesel fuel, and diesel exhaust fluid as required to support Contract work. Refer to the CSI Sections referenced below for additional information in this regard.

Motor Fuel Island: CSI Section 132160, "Installation of New Fuel Facility."
Generator: CSI Section 263213, "Engine Generators"

Materials: The Contractor shall provide fuels that conform to the requirements of the referenced CSI Sections. A sample from each tanker shall be tested to confirm the product's conformance to the Contract requirements UNLESS the fuel is supplied by one of the Department's current fuel vendors. The sample shall be taken in the presence of the Engineer.

Construction Methods: The Contractor shall fill all tanks to 90% of the rated capacity. The fuel shall remain in the storage tanks and shall become the property of the Engineer upon the acceptance of the Project. The Contractor is responsible for the fuel, including any leaks and spills until the Engineer accepts the Project.

Method of Measurement: The work and materials shall be measured for payment as provided for under Article 1.20-1.04.05 Extra Work.

The sum of money shown on the estimate and in the itemized proposal as "Estimated Cost" for this work will be considered the price bid even though payment will be made only for actual work performed. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded and the original price will be used to determine the total amount for the contract.

Basis of Payment: This work will be paid as Extra Work.

Pay Item	Pay Unit
Fuel Adjustment Cost	Estimated Cost

ITEM #1700001A – SERVICE CONNECTIONS (ESTIMATED COST)

Description:
This work shall consist of disconnection, alteration and reconnection of those existing utility services owned by property owners at locations necessary to complete this project and as ordered by the Engineer. This work shall include the coordination with the affected utility companies and customers. Any damage caused by the Contractor or Subcontractors, as determined by the Engineer, shall be corrected by the Contractor in accordance with this specification.

Material:
All materials shall be provided by the Contractor and shall meet the current standards of the affected service.

Construction Methods:
The Contractor shall perform all work in coordination with the Utility Company and affected property owner and as directed by the Engineer. Certain work may require use of a licensed and/or certified tradesman when such work is required by local and/or state codes.

Any utility customer's service interruption shall be done in a way that minimizes adverse impacts to the customer and affected utility.

Any work and materials supplied by the utility companies shall be on a billable basis to the Contractor.

Method of Measurement:
The work and materials shall be measured for payment as provided for under Article 1.04.05 Extra Work.

The sum of money shown on the estimate and in the itemized proposal as "Estimated Cost" for this work will be considered the price bid even though payment will be made only for actual work performed. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded and the original price will be used to determine the total amount for the contract.

Corrective work required to repair damage caused by the Contractor or its Subcontractors shall not be measured for payment.

Basis for Payment:
This work will be paid as Extra Work.

Pay Item	Pay Unit
Service Connections (Estimated Cost)	Estimated Cost

INDEX OF CSI-FORMATTED SPECIFICATIONS
AND CORRESPONDING ITEM NUMBER FOR
CONSTRUCTION OF A REPAIR FACILITY AND MAINTENANCE FACILITY
PUTNAM, CONNECTICUT
STATE PROJECT NO. 0115-0121

0100150A	074213	METAL WALL PANELS
0100150A	075419	POLYVINYL-CHLORIDE (PVC) ROOFING
0100150A	075420	CHECKLIST FOR ROOFING SYSTEM
0100150A	076200	SHEET METAL FLASHING AND TRIM
0100150A	077100	ROOF SPECIALTIES
0100150A	077200	ROOF ACCESSORIES
0100150A	078413	PENETRATION FIRESTOPPING
0100150A	078446	FIRE-RESISTIVE JOINT SYSTEMS
0100150A	079200	JOINT SEALANTS
0100150A	079500	EXPANSION CONTROL

DIVISION 8 - OPENINGS

0100150A	081113	HOLLOW METAL DOORS AND FRAMES
0100150A	083313	COILING COUNTER FIRE DOORS
0100150A	083323	OVERHEAD COILING DOORS
0100150A	083613	SECTIONAL DOORS
0100150A	085113	ALUMINUM WINDOWS
0100150A	085123	STEEL WINDOWS
0100150A	087100	DOOR HARDWARE
0100150A	088000	GLAZING
0100150A	089000	LOUVERS AND VENTS

DIVISION 9 - INTERIOR FINISHES

0100150A	092216	NON-STRUCTURAL METAL FRAMING
0100150A	093000	TILING
0100150A	094020	POLYACRYLATE MODIFIED TERRAZZO
0100150A	095123	ACOUSTICAL TILE CEILINGS
0100150A	096513	RESILIENT BASE AND ACCESSORIES
0100150A	096519	RESILIENT TILE FLOORING
0100150A	099113	EXTERIOR PAINTING
0100150A	099123	INTERIOR PAINTING

DIVISION 10 - SPECIALTIES

0100150A	101010	VISUAL DISPLAY SURFACES
0100150A	101400	SIGNAGE
0100150A	102113	TOILET COMPARTMENTS
0100150A	102213	STORAGE CRIBS
0100150A	102800	TOILET AND BATH ACCESSORIES

0100150A	104413	FIRE PROTECTION CABINETS
0100150A	104416	FIRE EXTINGUISHERS
0100150A	105113	METAL LOCKERS
0100150A	105700	BAY FURNISHINGS

DIVISION 11 - EQUIPMENT

0100150A	111000	VEHICLE SERVICE EQUIPMENT
0100150A	111400	VEHICLE WASHING EQUIPMENT
0100150A	113100	APPLIANCES

DIVISION 12 - FURNISHINGS

0100150A	122113	HORIZONTAL LOUVER BLINDS
0100150A	123530	CASEWORK

DIVISION 13 - SPECIAL CONSTRUCTION

0100150A	132160	INSTALLATION OF NEW FUEL FACILITY
0100150A	132180	TANK MONITORING SYSTEM
0100150A	133419	METAL BUILDING SYSTEMS

DIVISION 14 - CONVEYING EQUIPMENT

0100150A	144500	VEHICLE LIFTS
0100150A	146010	HOISTS AND CRANES

DIVISION 21 - FIRE SUPPRESSION

0100150A	210517	SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING
0100150A	211119	FIRE DEPARTMENT CONNECTIONS
0100150A	211313	WET-PIPE SPRINKLER SYSTEMS

DIVISION 22 - PLUMBING

0100150A	220516	EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
0100150A	220517	SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

0100150A	220518	ESCUTHEONS FOR PLUMBING PIPING
0100150A	220519	METERS AND GAGES FOR PLUMBING PIPING
0100150A	220523	GENERAL DUTY VALVES FOR PLUMBING PIPING
0100150A	220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
0100150A	220548	VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
0100150A	220553	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
0100150A	220719	PLUMBING PIPING INSULATION
0100150A	221116	DOMESTIC WATER PIPING
0100150A	221119	DOMESTIC WATER PIPING SPECIALTIES
0100150A	221123	DOMESTIC WATER PUMPS
0100150A	221316	SANITARY WASTE AND VENT PIPING
0100150A	221319	SANITARY WASTE PIPING SPECIALTIES
0100150A	221325	OIL-WATER SEPARATOR
0100150A	221413	FACILITY STORM DRAINAGE PIPING
0100150A	221423	STORM DRAINAGE PIPING SPECIALTIES
0100150A	221513	GENERAL-SERVICE COMPRESSED-AIR PIPING
0100150A	221519	GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS
0100150A	223400	FUEL-FIRED DOMESTIC WATER HEATERS
0100150A	224213	COMMERCIAL WATER CLOSETS AND URINALS
0100150A	224213	COMMERCIAL LAVATORIES AND SINKS
0100150A	224223	COMMERCIAL SHOWERS
0100150A	224233	WASH FOUNTAINS
0100150A	224500	EMERGENCY PLUMBING FIXTURES
0100150A	224716	PRESSURE WATER COOLERS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

0100150A	230516	EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
0100150A	230517	SLEEVES AND SLEEVE SEALS FOR HVAC PIPING
0100150A	230519	METERS AND GAGES FOR HVAC PIPING
0100150A	230523	GENERAL DUTY VALVES FOR HVAC PIPING
0100150A	230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
0100150A	230548	VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
0100150A	230553	IDENTIFICATION FOR HVAC PIPING AND

		EQUIPMENT
0100150A	230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
0100150A	230713	DUCT INSULATION
0100150A	230719	HVAC PIPING INSULATION
0100150A	230900	INSTRUMENTATION AND CONTROL FOR HVAC
0100150A	230993	SEQUENCE OF OPERATION FOR HVAC CONTROLS
0100150A	231123	FACILITY NATURAL-GAS PIPING
0100150A	232113	HYDRONIC PIPING
0100150A	232116	HYDRONIC PIPING SPECIALTIES
0100150A	232123	HYDRONIC PUMPS
0100150A	233113	METAL DUCTS
0100150A	233300	AIR DUCT ACCESSORIES
0100150A	233423	HVAC POWER VENTILATORS
0100150A	233713	DIFFUSERS, REGISTERS, AND GRILLES
0100150A	233813	COMMERCIAL-KITCHEN HOODS
0100150A	233823	INDUSTRIAL VENTILATING EQUIPMENT
0100150A	235100	BREECHINGS, CHIMNEYS, AND STACKS
0100150A	235223	CAST-IRON BOILERS
0100150A	237413	PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS
0100150A	238123	COMPUTER-ROOM AIR-CONDITIONERS
0100150A	238216	AIR COILS
0100150A	238233	CONVECTORS
0100150A	238236	FINNED-TUBE RADIATION HEATERS
0100150A	238239	UNIT HEATERS
0100150A	238316	RADIANT-HEATING HYDRONIC PIPING

DIVISION 26 - ELECTRICAL

0100150A	260501	ELECTRICAL EQUIPMENT FOR FUELING & TANKS
0100150A	260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
0100150A	260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
0100150A	260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
0100150A	260533	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
0100150A	260543	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

0100150A	260544	SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING
0100150A	260548	SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
0100150A	260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS
0100150A	260572	OVERCURRENT PROTECTIVE DEVICE SHORT CIRCUIT STUDY
0100150A	260574	OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY
0100150A	260923	LIGHTING CONTROL DEVICES
0100150A	262416	PANELBOARDS
0100150A	262419	MOTOR-CONTROL CENTERS
0100150A	262713	ELECTRICITY METERING
0100150A	262726	WIRING DEVICES
0100150A	262813	FUSES
0100150A	262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
0100150A	263213	ENGINE GENERATORS
0100150A	263600	TRANSFER SWITCHES
0100150A	264113	LIGHTNING PROTECTION FOR STRUCTURES
0100150A	264313	SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS
0100150A	265119	LED INTERIOR LIGHTING
0100150A	265613	LIGHTING POLES AND STANDARDS
0100150A	265619	LED EXTERIOR LIGHTING

DIVISION 27 - COMMUNICATIONS

0100150A	270000	PREMISES TELEPHONE WIRING
0100150A	274000	BASE STATION RADIO ANTENNA SYSTEM
0100150A	275116	PUBLIC ADDRESS SYSTEMS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

0100150A	282300	VIDEO SURVEILLANCE
0100150A	283111	DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

DIVISION 30 - SITE WORK

0100150A	300000	FORM 818 SITE WORK
0100150A	300500	TEMPORARY MAINTENACE WORK AREA
0100150A	302000	GENERAL SITE WORK
0100150A	304000	FENCING AND GATES

0100150A	305000	TURF ESTABLISHMENT
0100150A	307000	SANITARY/DRAINAGE

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY:

A. The Contractor shall engage the services of a qualified professional photographer and videographer to create a visual record of the construction of the Project.

1.2 INFORMATIONAL SUBMITTALS:

A. At the Preconstruction Meeting, submit to the Engineer for approval the name of the photographer and the videographer who will be responsible for taking the photographs and the videos during construction.

1.3 PHOTOGRAPHIC DOCUMENTATION SUBMITTALS:

A. Transmittal of Submittals: The Contractor shall transmit the photographs (including thumbnails), and the key plan in a zipped folder submittal package and upload into COMPASS – Contract Documents under the subfolder "160_Project Photos" under the project number main folder within 7 calendar days of taking the photographs. The specific work flow to do so will be distributed at the Preconstruction Meeting.

1. Submittal packages shall be limited to 250 MB; larger packages will need to be broken up.
2. After uploading photographs and the key plan, the Contractor shall provide e-mail notification to submittal reviewers and other key personnel at their business e-mail address that the submittals have been uploaded and are available for review. The Contractor shall provide a SharePoint link to the zipped folder submittal within their e-mail notification. The Contractor shall include the following information in the notification e-mail subject line in this order: "Project Number-Progress Photos #XX-Date".
3. The Contractor shall transmit (2) DVD's or flash drives of all training video recordings to the Owner through the Engineer as part of the Project Closeout process.

1.4 QUALITY ASSURANCE:

A. Photographer and Videographer Qualifications: A professional photographer and videographer with a minimum of 3 years' experience on construction projects.

1.5 FORMATS AND MEDIA:

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions. Individual images may be approximately 5 MB to allow the Department to print clear 8x10 photographs at a later date.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode with vibration-reduction technology. Provide supplemental lighting in low light levels or backlit conditions.

C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software. Include metadata to record the accurate date and time and GPS location data from camera.

1.6 CONSTRUCTION PHOTOGRAPHS AND VIDEO RECORDINGS:

A. General: The photographer shall take photographs with maximum depth of field and in focus. The photographer shall develop a key plan of the Project Site and building with notation of vantage points marked for location and direction of each photograph.

B. Pre-Construction: Before commencement of Project Work, the photographer shall take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by the Engineer. Flag construction limits before taking construction photographs. The photographer shall take 24 photographs to show existing conditions adjacent to property before starting the Work and of existing buildings either on or adjoining property to accurately record physical conditions at start of construction. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

C. Periodic: The photographer shall take 24 photographs monthly coinciding as closely as possible with the completion of a major construction phase. Select vantage points to show status of construction and progress since last photographs were taken. Prior to taking any photographs review the proposed vantage points with the Engineer. Photographs are for a record of the progress of work. Therefore, they shall be taken at a maximum interval of one month, whether or not they show any completion of work performed during the preceding month.

D. Final: The photographer shall 24 photographs after the date of Substantial Completion for submission as Project Record Documents. The Engineer will inform photographer of desired vantage points.

E. Additional: The Engineer may request photographs in addition to periodic photographs specified with as few as 3 calendar days' notice except in emergency situations when the photographer shall take additional photographs within 24 hours of the request. Circumstances that could require additional photographs include, but are not limited to, the following: (1) special events planned at Project Site; (2) immediate follow-up when on-site events result in construction damage or losses; (3) photographs to be taken at off-site fabrication locations; (4) Substantial Completion of a major phase or component of the Work; and (5) Owner's request for special publicity photographs.

F. Training: The videographer shall record each training session in accordance with subsection 5 of Form 818 Article 1.20-1.08.14.

1.7 PHOTOGRAPHIC DOCUMENTATION RELEASE:

A. The photographer and the videographer shall furnish to the Department a written photographic documentation release which states the following:

[Addressed to:]

Commissioner of Transportation
Department of Transportation
P.O. Box 317546
Newington, CT 06131-7546

Project Title and Number

We understand that all intellectual property rights associated with the photographic documentation prepared in direct service of the Contract shall transfer, along with the media itself, to the Department. We agree that said photographic documentation cannot be used for any purposes, including marketing, without the expressed written consent of the Department.

Signatures of Authorized Parties:

_____ _____
Photographer Signature Date

_____
Photographer Printed Name

_____ _____
Videographer Signature Date

_____
Videographer Printed Name

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

SECTION 017000 – CONSTRUCTION STAKING

PART 1 - GENERAL

1.1 SUMMARY:

A. The Contractor shall perform, including related administrative and procedural requirements, the following: construction layout and staking, field engineering and surveying, utility locations, general support services related to proposed construction methodology involving structural integrity or personnel safety, and civil engineering services.

B. Engage a Land Surveyor licensed in the State of Connecticut who is experienced in providing land-surveying services of the kind indicated.

C. Engage a Professional Engineer of the discipline required, licensed in the State of Connecticut, to perform engineering services of the kind indicated.

1.2 SUBMITTALS:

A. Submit a certificate signed by the Contractor and co-signed by a Land Surveyor or Professional Engineer certifying that the location and elevation of improvements comply with the Contract.

B. Submit a record of Project work performed and project data as required under provisions of Form 818 Article 1.20-1.08.14.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Project Record Drawings: Appropriate scale reproducible final drawings shall be submitted to the Engineer. Drawings shall conform to an “Existing Building Location Survey” with a Class T-2 accuracy standard in accordance with the Connecticut General Statues, Section 20-300b.

PART 3 - EXECUTION

3.1 EXECUTION:

A. The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction affecting the work. Furnish location data for Project work that must be performed by public utilities serving the Project Site.

B. Furnish information that is necessary to adjust, move or relocate existing structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

C. The existing benchmarks, control points and property corners are shown on the plans.

D. Verify layout information shown on the plans, in relation to the control points and existing benchmarks before proceeding to layout the Project work. Notify the Engineer if discrepancies are discovered. Locate existing permanent benchmarks, control points, and similar reference points before beginning Project work. Preserve and protect permanent benchmarks and control points during construction operations. Do not change or relocate benchmarks or control points without the Engineer's prior written approval. Promptly report lost or destroyed control points, or the need to relocate permanent benchmarks or control points because of necessary changes in grades or locations. Promptly replace lost or destroyed benchmarks and control points. Base replacements on the original survey control points.

E. Establish and maintain a minimum of (2) permanent benchmarks on the Project Site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark. Record benchmark locations, with horizontal and vertical data, on Project Record Documents. Provide temporary reference points sufficient to locate the work where the actual location or elevation of layout points cannot be marked. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

F. Construction methodology shall be the Contractor's sole responsibility including the cost of using engineering services and recommendations as necessary. Inform the Engineer of any anticipated or encountered problems in construction methodology. Proceed with work only when such problems are fully resolved by the Contractor, using such engineering support services as required.

G. Work from lines and levels established by the control survey. Establish benchmarks and control points to set lines and levels at each area of construction as needed to locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale plans to determine dimensions. Advise entities engaged in construction activities, of marked lines and levels provided for their use. As construction proceeds, check every major element for line, level and plumb.

H. Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes and invert elevations by instrumentation and similar appropriate means. The Contractor shall identify and document by survey the extent, elevation, and location of all foundations and capped utilities to be left in place and backfilled. Appropriate scaled marked up drawings shall be furnished to the Engineer PRIOR to backfilling.

I. Locate and lay out control lines and levels for structures, building foundations, column grids and locations, floor levels including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from (2) or more locations.

J. Maintain a surveyor's log of control and other survey work. Make this log available to the Engineer for reference. Record deviations from required lines and levels, and advise the Engineer when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted by the Engineer and not corrected. Record the location of utilities at the time of installation in the log as well as on the As-Built drawings for permanent record. The recording Land Surveyor shall place its registration seal and accuracy statement regarding location of exterior underground utility lines on the utility plans of As-Built drawings.

END OF SECTION 017000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section specifies Cast-in-Place Concrete as indicated on the Contract Plans.

B. Related CSI Sections include the following:

1. Division 05 Section 055000, "Metal Fabrications" for furnishing metal embedment.
2. Division 07 Section 071113, "Bituminous Damp-proofing" for perimeter damp-proofing.
3. Division 07 Section 071900, "Water Repellents" for concrete surfaces.
4. Division 07 Section 079200, "Joint Sealants" for expansion joint over one inch, and perimeter and joint sealants for floor and wall joints.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For proprietary materials and items, including reinforcement and forming accessories, admixtures, joint systems, curing compounds, water repellents, sealants, colored hardener and others if requested by the Designer.

C. Shop Drawings: For reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 Detailing Manual – SP-66(94) showing bar schedules, stirrup spacing, bent bar diagrams, splices and laps and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures. For slabs with mechanically-connected steel reinforcement, indicate anchors and inserts locations, proposed locations of all control, expansion and construction joints not otherwise shown on the plans.

D. Quality Assurance Submittals:

1. Laboratory test reports for concrete materials and mix design test.
2. Material certificates in lieu of material laboratory test reports when permitted by Engineer. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

3. Evidence that concrete materials were tested and the test results are on file with the State of Connecticut Department of Transportation, Office of Research and Materials, Division of Materials Testing.
4. Certified Materials Test Reports for each lot of reinforcement showing that it complies with ASTM A 615.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified:

1. State of Connecticut Department of Transportation "Form 818," "Standard Specification for Roads, Bridges, Facilities and Incidental Construction"
2. ACI 301, "Specifications for Structural Concrete for Buildings."
3. ACI 318, "Building Code Requirements for Reinforced Concrete."
4. CRSI, "Manual of Standard Practice."
5. ACI 315, "Details and Detailing of Concrete Reinforcement"
6. ACI 347, "Recommended Practice for Concrete Formwork"
7. ACI 304R, "Recommended Practice for Measuring, Mixing, Transportation and Placing Concrete"
8. ACI 302.1R, "Guide for Concrete Floor and Slab Construction"
9. ACI 305R, "Hot Weather Concreting"
10. ACI 306R, "Cold Weather Concreting"
11. ACI 306.1, "Standard Specifications for Cold Weather Concreting"
12. ACI 308, "Standard Practice for Curing Concrete"
13. 309R "Standard Practice for Consolidating of Concrete"
14. ACI 211.1, "Standard Practice for Selecting Proportions for Normal, Heavy Weight and Mass Concrete"
15. ACI 303.1 "Standard Specifications for Cast-In-Place Architectural Concrete"
16. ASTM C309 "Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete"
17. ASTM C494 "Standard Specifications for Chemical Admixtures for Concrete"

B. Testing Agency Qualifications: The Contractor shall engage the services of an independent agency, acceptable to the Engineer to perform material evaluation tests and to design concrete mixes, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

C. Concrete and concrete materials may require testing and retesting at any time during the progress of work. Tests for all installed work, including the re-testing of rejected materials shall be done at the Contractor's expense.

D. Concrete Testing Service: The Contractor shall engage the services of a qualified independent testing agency, acceptable to the Engineer, to perform material evaluation tests and to design concrete mixtures.

E. Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 818 Article 1.20-1.05.24, subsection 2.

1. At least 35 calendar days prior to submitting design mixes, conduct a meeting to review detailed requirements for preparing concrete design mixes and to determine procedures for satisfactory concrete operations. Review requirements for submittals, status of coordinating work, and availability of materials. Establish materials inspection, testing, and certifications. Require representatives of each entity directly concerned with cast-in-place concrete to attend the meeting.

F. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures and color hardener through one source from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Refer to Form 818 Article 1.06.03 and Form 818 Article 1.20-1.06.03 for additional information.

B. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement. Repair damaged epoxy coatings on steel reinforcement according to ASTM D 3963.

C. Water-stops: Store water-stops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS:

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel type material that will provide continuous, true, and smooth, exposed concrete surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on the plans.

1. Use overlaid plywood complying with DOC PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I or better.
2. Use plywood complying with DOC PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. Forms for Unexposed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Form-Release/De-bonding Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces. Comply with local regulations controlling use of volatile organic compounds (VOC's).

E. Form Ties: Factory-fabricated, adjustable length, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Provide units that will leave no corrodible metal closer than 1-1/2 inches to the plane of the exposed concrete surface.
2. Provide ties that, when removed, will leave holes not larger than 1 inch in diameter in the concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT:

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Epoxy-Coated Reinforcing Bars: ASTM A 775, with less than 2 percent damaged coating in each 12-inch bar length.

C. Plain-Steel Wire: ASTM A 1064/A 1064M

D. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

E. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884, Class A coated, Type 1, deformed steel.

2.3 REINFORCEMENT ACCESSORIES:

A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars. Cut bars true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, ASTM A 775 epoxy coated. Cut bars to true length with ends square and free of burrs.

C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar

supports from steel wire, plastic, or pre-cast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

E. Mechanical connections that develop the ACI 318 full tension splice strength of 125% of the specified yield strength of the reinforcing steel.

2.4 CONCRETE MATERIALS:

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type 1 or II, gray. Do not use air-entraining cement.
2. Fly Ash: ASTM C618, Type C or F.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
4. Silica Fume: ASTM C 1240, amorphous silica.

B. Normal-Weight Aggregates: ASTM C 33, Class 3S. Provide aggregates from a single source for exposed concrete.

1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.
2. Provide evidence that all aggregates are non-reactive with alkaline when tested in accordance with ASTM C 289 and C 227.
3. Local aggregates not complying with ASTM C 33 but has shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to the Engineer.

C. Water: ASTM C 94, clean in appearance and free from oil, soil, salt, acids, alkalis, sugar and organic matter. The Engineer may request that the water from any surface and ground source be tested in accordance with ASTM C 94 if the appearance or scent of the water is suspect.

2.5 ADMIXTURES:

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
3. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

C. Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

2.6 WATERSTOPS:

A. Flexible PVC Water-stops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory-fabricate corners, intersections, and directional changes. Size to suit joints.

1. Profile: Flat, dumbbell with center bulb or approved equal.

2.7 VAPOR RETARDERS:

A. Plastic Vapor Retarder: ASTM E 1745, Class C or reinforced polyethylene sheet, ASTM D 4397, not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape. Shall be applied in the entire underside of Slab-on-Grade in buildings, as called out on the Plans.

2.8 CURING MATERIALS:

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry. No curing membranes can be used on slabs-on grade and slab above the basement.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Clean and potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, non-dissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

2.9 RELATED MATERIALS:

A. Expansion and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semi-rigid Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with a Type A Shore Durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Sealer for floors and vertical surfaces of masonry walls: Refer to CSI SECTION 071900 – "Water Repellents".

F. Chemical Anchoring Compound: Chemical Anchoring Compound of polyester, vinylester or epoxy used for the post-installation of rebar dowels, threaded rods, anchor bolts and inserts into new or existing concrete. The Chemical Anchoring Compound shall have the capability to sustain without failure, a shear and tensile load equal to six times the load imposed when installed in solid or grouted unit masonry, and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E488 conducted by a qualified independent testing agency. The installation of the complete anchoring system shall be as specified by the manufacturer of the Chemical Anchoring Compound. Available products include but are not limited to the following:

1. Hilti HIT HY 70 (with screen tube)
2. Hilti Hit HY 200 MAX Adhesive Anchoring System
3. Simpson Strong Tie SET High Strength Epoxy

G. Compacted Granular Fill: Refer to Form 818, Section 2.14 "Compacted Granular Fill, for the required material and construction method.

2.10 REPAIR MATERIALS:

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate conditions and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Over-layment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.

C. Penetrating Sealer: Slabs-on-Grade that are exposed to weather and the elements, such as but not limited to the slab for a Fuel Island, or as indicated on the Plans, shall receive a coating of penetrating sealer applied in accordance with the manufacturer's written instructions. Provide a certification by the manufacturer that the product complies with Table 41-1 of Section 22a-174-1 of the Regulations of Connecticut State Agencies controlling the use of Volatile Organic Compounds (VOC). Available products include, but are not limited to the following:

1. Hydrozo Silane 40M and Hydrozo Enviroseal 40 by Hydrozo.
2. Masterseal SL40 by Master Builders
3. Penetrating Sealer 40 by Sonneborn Building Products.

2.11 CONCRETE MIXTURES, GENERAL:

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:

1. Fly Ash: 20 percent.
2. Slag Cement: 30 percent
3. Silica Fume: 10 percent

C. Limit water-soluble, chloride-ion content in hardened concrete to 250 ppm.

D. Admixtures: Use admixtures according to manufacturer's written instructions and only when approved by the Engineer.

1. Use water-reducing high-range water-reducing or plasticizing admixture in all concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture in all concrete when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, except footings, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use non-chlorine accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F.
5. Use corrosion-inhibiting admixture in the concrete for Salt Shed walls and piers and in the concrete slab for weather-exposed Equipment Pads. The corrosion-inhibiting admixture shall contain calcium nitrite at 4 gal. per cubic yard of a 30 percent solid solution.
6. No admixtures containing calcium chloride shall be permitted in Slabs-on-Grade and other concrete floors.

2.12 CONCRETE MIXTURE FOR STRUCTURES:

A. Normal-Weight, Class ‘F’ Concrete shall be used for appurtenant concrete structures on the Contract Plans. Proportion the Normal-Weight, Class ‘F’ Concrete Design Mix as follows:

1. Minimum Compressive Strength: 4400 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.44.
3. Slump Limit: not less than 1 inch and not more than 4 inches before adding high-range water-reducing admixture or plasticizing admixture.
4. Air Content**:** 6 percent, plus or minus 1.5 percent at point of delivery
5. Maximum Aggregate Size: No. 6
6. Minimum Cement Required: 658 Lbs./Cu. Yd.

2.13 FABRICATING REINFORCEMENT:

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING:

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd, increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK:

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch for concrete surfaces exposed to view.
2. Class B, 1/4 inch for other concrete surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of concrete that are permanently exposed to view.

I. Form openings, chases, offsets, sinkages, keyways, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS:

A. Place and secure anchorage devices and other embedded items that are to be attached to, or be supported by Cast-in-Place Concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 REMOVING AND REUSING FORMS:

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to

not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 VAPOR RETARDERS:

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturers recommended tape.

3.5 STEEL REINFORCEMENT:

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

1. Use epoxy-coated reinforcing bars for all concrete exposed to salt such as, but not limited to Slabs-on-Grade, walls of Salt Sheds and slab for Fuel Islands.

3.6 JOINTS:

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by the Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in CSI Division 07 Section 079200, "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 WATERSTOPS:

A. Flexible Water-stops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed water-stops during progress of the Work. Field-fabricate joints in water-stops according to manufacturer's written instructions.

3.8 CONCRETE PLACEMENT:

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project Site, or during placement unless approved by the Engineer.

C. Before test sampling and placing concrete, water may be added at Project Site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete shall be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed-water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen sub-grade or on sub-grade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and sub-grade just before placing concrete. Keep sub-grade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES:

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and other defects. Repair tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view or not to be covered with a coating or covering material applied directly to concrete.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

C. Rubbed Finish: Apply the following to smooth-formed finish and exposed-to-view concrete.

1. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS:

A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

1. Slab for Fuel Islands. Edge, float and groove the slab when all traces of water are gone and the concrete starts to harden. Start by running the edger around the perimeter to round and compact the corners. After finishing edging, start slab float and trowel the surface to smooth and compact. Floating removes the marks left by edging. After finishing slab floating, start the grooving process at the slab surrounding the pump island. Use a straightedge and proper groove tool.

B. Scratch Finish: While concrete is still plastic, texture the concrete surface that has been screeded, bull-floated or darbied. Use a stiff brush, broom, or rake to produce surface profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish on surfaces that are indicated on the architectural plans to receive concrete floor toppings or mortar setting bed for bonded cementitious floor finishes including ceramic floor tiles, and on surfaces designed to receive penetrating liquid floor treatment and sealant.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Re-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straighten until surface is left with a uniform, smooth, granular texture.

1. Apply float finish on surfaces indicated to receive trowel finish and on surfaces to be covered with fluid-applied sheet-waterproofing or built-up membrane water-proofing.

D. Trowel Finish: After applying float-finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind-smooth any surface defects that would project through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated to be exposed to view or to be covered with resilient flooring, carpet, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 for a randomly trafficked floor surface:

   a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.

3. Finish and measure surface so that a gap at any point between concrete surface and an unleveled, freestanding, 10-foot- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. The slab shall be uniform in appearance. The broom finish shall not dislodge aggregate nor leave large particles of cement paste which not conform to the broom finish. Coordinate required final finish with Engineer before application.

3.11 MISCELLANEOUS CONCRETE ITEMS:

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish. All corners, intersections, and terminations shall be slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on the plans. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.12 CONCRETE PROTECTING AND CURING:

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing. Do not use curing membranes on slabs-on-grade and concrete floors generally in areas of etched floors.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.

b. Continuous water-fog spray.

c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 CONCRETE SURFACE REPAIRS:

A. Defective Concrete: Repair and patch defective areas when approved by the Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/4 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, pop-outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact,

and finish to-blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.14 FIELD QUALITY CONTROL:

A. Testing and Inspecting: The Contractor shall engage the services of a qualified independent testing agency, acceptable to the Engineer, to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.
6. Verification of concrete strength before removal of shores and forms.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd. , plus one set for each additional 50 cu. yd. or fraction thereof.

   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete: one test for each composite sample, but not less than one test for each day's pour of each composite mixture.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.

    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi .
9. Test results shall be reported in writing to the Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer.
12. Installed work may require testing and retesting at any time during the progress of work. Installed work determined to be not in compliance with the specifications shall be rejected and be replaced by the Contractor at Contractor's expense.

Additional testing and inspecting, at Contractor's expense, will be performed to determine the compliance of replacement or additional work with the specified requirements.

13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract.

D. At Contractor’s expense and solely dependent on the Contractor’s schedule of concrete pour, measure floor and slab flatness, levelness and slopes for drainage requirements according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION 033000

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes unit masonry assemblies consisting of the following:

1. Concrete Masonry Units (CMU)
2. Prefaced Concrete Masonry Unit
3. Mortar and Grout
4. Reinforcing Steel
5. Masonry Joint Reinforcement
6. Masonry Ties and Anchors
7. Embedded Flashing.
8. Shear-Tension Anchor Bolts
9. Cavity-wall Insulation
10. Concrete Block Veneer
11. Brick
12. Post-installed (Chemically-Installed) Anchor Bolts and Reinforcing Bars
13. Miscellaneous Masonry Accessories

B. Related CSI Sections include the following:

1. Division 07 Section 07113, "Bituminous Dampproofing" for dampproofing applied to cavity face of backup wythes of cavity walls.
2. Division 07 Section 071900, "Water Repellents" for water repellents applied to unit masonry assemblies.
3. Division 07 Section 076200, "Sheet Metal Flashing and Trim" for sheet metal flashing.
4. Division 07 Section 078413, "Penetration Firestopping" for firestopping at openings in masonry walls.
5. Division 07 Section 079200, "Joint Sealants" for sealing control and expansion joints in unit masonry.
6. Division 08 Section 089000, "Louvers and Vents" for wall vents (brick vents).

C. Products furnished, but not installed, under this Section include the following:

1. Dovetail slots for masonry anchors, installed under CSI Division 03 Section 033000, "Cast-in-Place Concrete."
2. Anchor sections of adjustable masonry anchors for connecting to structural frame installed under CSI Division 05 Section 051200, "Structural Steel Framing."

D. Products installed, but not furnished, under this Section include the following:

1. Steel lintels and shelf angles for unit masonry, furnished under CSI Division 05 Section 055000, "Metal Fabrications."
2. Manufactured reglets in masonry joints for metal flashing, furnished under CSI Division 07 Section 076200, "Sheet Metal Flashing and Trim."

1.2 DEFINITIONS:

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PERFORMANCE REQUIREMENTS:

A. Provide unit masonry that develops indicated net-area compressive strengths (f'_m) at 28 days.

B. Determine net-area compressive strength (f'_m) of masonry from average net-area compressive strength of masonry units and mortar types according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602 .

1. For Concrete Masonry: f'm = 1500 psi.

1.4 SUBMITTALS:

A. Submit the following in accordance with Form 818, Article 1.20-1.05.02 and <u>NOTICE TO CONTRACTOR-SUBMITTALS.</u>

B. Product Data: For each type of product indicated.

C. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls, arrangement of masonry reinforcement, control joint locations, bond beam construction and layout.
3. Fabricated Flashing: Detail corner units, end-dam units and other special applications.

D. Product Samples for Initial Selection: For the following:

1. Decorative Concrete Masonry Units in the form of small-scale units.
2. Face blocks and glazed blocks in the form of straps of five or more blocks. Colors to be selected by the Engineer from the submitted samples.
3. Colors for the Smooth-Face C.M.U. (SMO) and Split-Face C.M.U. (SPL) to be selected by the Engineer from the submitted samples.

4. Brick to closely match material properties and general appearance of the masonry-brick walls in the existing adjacent structure. The Architect/Designer shall select the materials to be used from the samples presented for consideration
5. Colored mortar.
6. Weep holes and/or vents.

E. Qualification Data: For testing agency.

F. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units.

   a. Include material test reports substantiating compliance with requirements.
   b. For masonry block veneer, include size-variation data verifying that actual range of sizes falls within specified tolerances.

2. Grout and mortar mixes. Include description of type and proportions of ingredients.
3. Reinforcing bars.
4. Joint reinforcement.
5. Anchors, ties and metal accessories.

G. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

H. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

I. Cold-Weather Procedures: Detailed description of methods, materials and equipment to be used to comply with cold-weather requirements.

1.5 QUALITY ASSURANCE:

A. Testing Agency Qualifications: The Contractor shall engage the services of an independent agency, acceptable to the Engineer, qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

B. 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, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Preconstruction Testing Service: The Engineer's Laboratory will perform preconstruction testing indicated below. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

1. Clay Masonry Unit Test: For each type of unit required, per ASTM C 67.
2. Concrete Masonry Unit Test: For each type of unit required, per ASTM C 140.
3. Mortar Test (Property Specification): For each mix required, per ASTM C 780.
4. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019.

E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness or by other means, as acceptable to authorities having jurisdiction.

F. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects.

1. Build sample panels for each type of exposed unit masonry construction typical exterior wall typical interior wall typical exterior and interior walls in sizes approximately 48 inches long by 48 inches high by full thickness.
2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
3. Clean exposed faces of panels with masonry cleaner indicated.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Designer in writing.

    a. Approval of sample panels does not constitute approval of deviations from the Contract contained in sample panels unless such deviations are specifically approved by Designer in writing.

6. Demolish and remove sample panels when directed.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS:

A. Protection of Masonry: During construction, cover tops of walls, projections and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges and projections from mortar droppings.
3. Protect surfaces of window and door frames as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. In other portions of Part 2 where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 MASONRY UNITS, GENERAL:

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.3 CONCRETE MASONRY UNITS (CMU):

A. Shapes: Provide shapes indicated and as follows:

1. Provide special shapes for bond beams, lintels, corners, jambs, sashes, movement joints, headers, bonding and other special conditions.
2. Provide square-edged units for outside corners, unless otherwise indicated.

B. Concrete Masonry Units: ASTM C 90 and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.

2. Weight Classification: Lightweight, unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by approved sample.

C. Pre-Faced Concrete Block:

1. Concrete Block for Glazing: ASTM C 90 for hollow and solid load-bearing walls, Type 1 (moisture controlled).
2. Waterproof surface with Smooth, Satin Finish.
3. Color: As selected by Designer from Manufacturer's established colors.
4. Provide special shapes where required for corners, jambs, coved bases, sills, and other special conditions indicated, including applications that cannot be produced by sawing standard units.

    a. Provide bullnose units for outside corners unless otherwise indicated.
    b. Provide coved internal corners.
    c. Provide recessed, coved base units.

D. Architectural Concrete Masonry Units:

1. Face: Split Face (SPL): rough exposed aggregate, uneven natural split texture.
2. Face: Smooth Face (SMO): machine ground, smooth exposed aggregate texture.
3. Color: As selected by Designer from Manufacturer's full line of each specified face.

E. Architectural Brick:
1. Color: as selected by Designer from Manufacturer's established colors to match existing structure as closely as possible.

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of Portland cement complying with ASTM C 150, Type I or Type III and hydrated lime complying with ASTM C 207.

D. Masonry Cement: ASTM C 91.

1. Available Products:

    a. Capital Materials Corporation; Flamingo Color Masonry Cement.

b. Essroc, Italcementi Group; Brixment or Velvet.
c. Holcim (US) Inc.; Mortamix Masonry Cement, Rainbow Mortamix Custom Buff Masonry Cement, White Mortamix Masonry Cement.
d. Lafarge North America Inc.; Magnolia Masonry Cement, Lafarge Masonry Cement, Florida Super Masonry, Trinity Super White Masonry Type S, Trinity White Masonry Type N.
e. Lehigh Cement Company; Lehigh Masonry Cement Lehigh White Masonry Cement.
f. National Cement Company, Inc.; Coosa Masonry Cement.

E. Mortar Cement: ASTM C 1329.

1. Available Products:

a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Available Products:

a. Bayer Corporation, Industrial Chemicals Div.; Bayferrox Iron Oxide Pigments.
b. Davis Colors; True Tone Mortar Colors.
c. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.

G. Colored Cement Product: Packaged blend made from Portland cement and lime, masonry cement or mortar cement and mortar pigments, all complying with specified requirements and containing no other ingredients.

1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
2. Pigments shall not exceed 10 percent of Portland cement by weight.
3. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
4. Available Products:

a. Colored Portland Cement-Lime Mix:

1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
3) Lafarge North America Inc.; Eaglebond.
4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.

b. Colored Masonry Cement:

1) Capital Materials Corporation; Flamingo Color Masonry Cement.
2) Essroc, Italcementi Group; Brixment-in-Color.
3) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
4) Lafarge North America Inc.; Florida Custom Color Masonry or Magnolia Masonry Cement.
5) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
6) National Cement Company, Inc.; Coosa Masonry Cement.

c. Colored Mortar Cement:

1) Lafarge North America Inc.; Magnolia Superbond Mortar Cement.

H. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Aggregate for Grout: ASTM C 404.

J. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.

K. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Available Products:

a. Addiment Incorporated; Mortar Kick.
b. Euclid Chemical Company (The); Accelguard 80.
c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.
d. Sonneborn, Div. of ChemRex; Trimix-NCA.

L. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.

1. Available Products:

a. Addiment Incorporated; Mortar Tite.
b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
c. Master Builders, Inc.; Color Cure Mortar Admix or Rheomix Rheopel.

M. Water: Potable.

2.5 REINFORCEMENT:

A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: W1.7 or 0.148-inch diameter.
4. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
5. Wire Size for Veneer Ties: W1.7 or 0.148-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Multiwythe Masonry:

1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches in width, plus 1 side rod at each wythe of masonry 4 inches or less in width.
2. Tab type, either ladder or truss design, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.

2.6 TIES AND ANCHORS:

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with eight subparagraphs below, unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153.
4. Stainless-Steel Sheet: ASTM A 666, Type 304.
5. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Corrugated Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from steel sheet, galvanized after fabrication not less than 0.043 inch thick.

C. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units or hollow units laid with cells horizontal.
2. Where wythes are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
3. Wire: Fabricate from 3/16-inch diameter, hot-dip galvanized steel wire.

E. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.188-inch- diameter, hot-dip galvanized steel wire.

F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153.

G. Adjustable Masonry-Veneer Anchors

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs and as follows:

a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.

2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

a. Anchor Section: Sheet metal plate, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch

wide by 3-5/8 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie.

b. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and extend beyond pronged legs.

c. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.188-inch- diameter, hot-dip galvanized steel wire.

d. Available Products:

1) Dayton Superior Corporation, Dur-O-Wal Division; D/A Series.
2) Heckmann Building Products Inc.; 315-D with 316.
3) Hohmann & Barnard, Inc.; DW Series.
4) Wire-Bond; 1004, Type III.

3. Slip-in, Masonry-Veneer Anchors: Units consisting of a wire tie section and an anchor section designed to interlock with metal studs and be slipped into place as sheathing is installed.

a. Wire-Type Anchor: Bent wire anchor section with an eye to receive the wire tie. Wire tie has a vertical leg that slips into the eye of anchor section and allows vertical adjustment. Both sections are made from 3/16-inch, hot-dip galvanized wire.

4. Seismic Masonry-Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in the veneer mortar joint.

a. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches wide by 3 inches high; with projecting tabs having slotted holes for inserting vertical leg of connector section.

b. Connector Section: Rib-stiffened, sheet metal bent plate with down-turned leg designed to fit in anchor section slot and with integral tabs designed to engage continuous wire. Size connector to extend at least halfway through veneer but with at least 5/8-inch cover on outside face.

c. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches wide by 3 inches high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor

d. Available Products:

1) Dayton Superior Corporation, Dur-O-Wal Division; D/A 213S.
2) Hohmann & Barnard, Inc.; DW-10-X-Seismiclip.
3) Wire-Bond; RJ-711 with Wire-Bond clip.

5. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except manufactured with hex washer head and neoprene washer,

No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads.

a. Available Products:

1) Dayton Superior Corporation, Dur-O-Wal Division; Stainless Steel SX Fastener.
2) ITW Buildex; Scots long life Teks.

2.7 MISCELLANEOUS ANCHORS:

A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of dimensions indicated.

B. Post-installed Anchor Bolts, Threaded Rods, Inserts and Rebar Dowels: Provide Chemical Anchoring Compound of polyester, vinylester or epoxy to post-install anchor bolts, threaded rods, inserts and rebar dowels, with the capability to sustain, without failure, a shear and tensile load equal to six times the load imposed when installed in solid or grouted unit masonry, and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency. The installation of the complete anchoring system shall be as specified by the manufacturer of the Chemical Anchoring Compound.

a. Available Products:

1) Hilti HIT HY 70 (with screen tube)

2) Hilti HIT HY 200 MAX Adhesive Anchoring System

3) Simpson Strong Tie SET High Strength Epoxy

2.8 EMBEDDED FLASHING MATERIALS:

A. Metal Flashing: Provide metal flashing complying with CSI Division 07 Section 076200, "Sheet Metal Flashing and Trim."

2.9 MISCELLANEOUS MASONRY ACCESSORIES:

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with

ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use one of the following, unless otherwise indicated:

1. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch OD by 4 inches long.
2. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

    a. Available Products:

        1) Advanced Building Products Inc.; Mortar Maze weep vent.
        2) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
        3) Heckmann Building Products Inc.; No. 85 Cell Vent.
        4) Hohmann & Barnard, Inc.; Quadro-Vent.
        5) Wire-Bond; Cell Vent.

3. Vinyl Weep Hole/Vent: One-piece, offset, T-shaped units made from flexible, injection-molded PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units and a top flap to keep mortar out of the head joint; in color approved by Designer to match that of mortar.

    a. Available Products:

        1) Hohmann & Barnard, Inc.; #343 Louvered Weep Hole.
        2) Williams Products, Inc.; Williams-Goodco Brick Vent.
        3) Wire-Bond; Louvered Weepholes.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Available Products:

    a. Advanced Building Products Inc.; Mortar Break, Mortar Break II.
    b. Archovations, Inc.; CavClear Masonry Mat.
    c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
    d. Mortar Net USA, Ltd.; Mortar Net.

F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are

formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.

1. Available Products:

    a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 818.
    b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
    c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
    d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 CAVITY-WALL INSULATION:

A. Insulation is provided under CSI Division 07 Section 072100, "Thermal Insulation."

2.11 MASONRY CLEANERS:

Masonry Cleaners: Cleaners designed for removing mortar/grout stains, efflorescence and other types of stains without discoloring or damaging masonry surfaces.

2.12 MORTAR AND GROUT MIXES:

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds or other admixtures, unless otherwise indicated.

    1. Do not use calcium chloride in mortar or grout.
    2. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

    1. For masonry below grade or in contact with earth, use Type M.
    2. For reinforced concrete block masonry, use Type S.
    3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; for exterior brick veneer and for other applications where another type is not indicated, use Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of Portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
3. Mix to match the approved sample.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match the approved sample.

F. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

G. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

   1. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

H. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:

   1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet, or 1/2 inch maximum.
   2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than, 1/4 inch in 20 feet, or 1/2 inch maximum.
   4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
   5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.3 LAYING MASONRY WALLS:

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in pattern indicated on plans; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down

into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.

3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with CSI Division 7 Section 078446, “Fire-Resistive Joint Systems."

3.4 MORTAR BEDDING AND JOINTING:

A. Lay hollow concrete masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool all joints, exposed and facing the cavity, slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.5 CAVITY WALLS:

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. of wall area spaced not to exceed 36 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.

   a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.

b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.

2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.

a. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.

3. Header Bonding: Provide masonry unit headers extending not less than 3 inches into each wythe. Space headers not over 8 inches clear horizontally and 16 inches clear vertically.
4. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Coat cavity face of backup wythe to comply with CSI Division 07 Section 071113, "Bituminous Dampproofing."

D. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.6 MASONRY JOINT REINFORCEMENT:

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 ANCHORING MASONRY TO STRUCTURAL MEMBERS:

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 ANCHORING MASONRY VENEERS:

A. Anchor masonry veneers to concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten anchors to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of masonry backup.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 32 inches o.c. horizontally, with not less than 1 anchor for each 3.5 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36inches, around perimeter.

3.9 CONTROL AND EXPANSION JOINTS:

A. General: Install control and expansion joint materials in unit masonry as masonry progresses where indicated. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Install preformed control-joint gaskets designed to fit standard sash block.

C. Form expansion joints in brick made from clay or shale as follows:

1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in CSI Division 07 Section 079200, "Joint Sealants."

D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in CSI Division 07 Section 079200, "Joint Sealants," but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.10 LINTELS:

A. Install steel lintels where indicated.

3.11 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS:

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges other obstructions to downward flow of water in wall and where indicated.

B. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer Wythe, turned up a minimum of 8 inches, and through inner Wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner Wythe and turn flashing up approximately 2 inches on interior face unless otherwise indicated.
3. At lintels and shelf angles, extend flashing a minimum of 4 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 4 inches at ends and turn up not less than 2 inches to form end dams.
4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
5. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches o.c., unless otherwise indicated.

E. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches, to maintain drainage.

3.12 REINFORCED UNIT MASONRY INSTALLATION:

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.13 FIELD QUALITY CONTROL:

A. Testing Agency: The Contractor shall engage the services of an independent testing agency, acceptable to the Engineer, to perform field tests and inspections indicated below and prepare test reports:

1. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

B. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

C. Clay Masonry Unit Test: For each type of unit provided, per ASTM C 67.

D. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.

E. Mortar Test (Property Specification): For each mix provided, per ASTM C 780.

F. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.

3.14 REPAIRING,TOOTHING, POINTING, AND CLEANING:

A. Remove and replace masonry units that are loose, chipped, broken, stained or otherwise damaged or that do not match adjoining units. Use cutting methods to minimize damage of existing masonry such as hand tools or small power tools. Install new units by toothing masonry to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes and completely fill with mortar. Point up joints, including corners, openings and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Engineer's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.15 MASONRY WASTE DISPOSAL:

A. Excess Masonry Waste: Remove excess masonry waste and dispose legally off Owner's property.

END OF SECTION 042000

SECTION 047200 - PRECAST WINDOW SILL

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Precast window sill.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR-SUBMITTALS.

B. Product Data: For each type of product.

1. For precast window sill units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: Show fabrication and installation details for precast window sill. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations.

D. Samples for Verification:

1. For each color and texture of precast sill required, 5 inches (127 mm) square in size.

E. Material Test Reports: For each mix to produce precast window sill, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing.

1.3 QUALITY ASSURANCE:

A. Manufacturer Qualifications: A qualified manufacturer of precast-stone units similar to those indicated for this Project that has sufficient production capacity to manufacture required units, and is a plant-certified by the Cast Stone Institute.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. The Contractor shall coordinate the delivery of precast window sill with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.

B. Pack, handle, and ship cast-stone units in suitable packs or pallets.

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast-stone units if required, using dollies with wood supports.
2. Store precast window sill units on wood skids or pallets with non-staining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

1.5 PROJECT CONDITIONS:

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when the air temperature is 40 degrees F (4 degrees C) and above, and will remain so until precast sill has dried, but no fewer than seven days after completing cleaning.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Source Limitations for Precast Sill: Obtain precast window sill units from a single source and from a single manufacturer.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

2.2 MATERIALS:

A. General: Comply with ASTM C 1364.

B. Portland Cement: ASTM C 150/C 150M, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C 114. Provide natural color or white cement as required to produce cast-stone color indicated.

C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33/C 33M; gradation and colors as needed to produce required cast-stone textures and colors.

D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33/C 33M, gradation and colors as needed to produce required cast-stone textures and colors.

E. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable non-fading, and resistant to lime and other alkalis.

F. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M, Grade 60 (Grade 420). Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches (38 mm) of cast-stone material.

1. Epoxy Coating: ASTM A 775/A 775M.
2. Galvanized Coating: ASTM A 767/A 767M.

G. Water: Potable

2.3 PRECAST WINDOW SILL:

A. Comply with ASTM C 1364.

1. Units shall be manufactured using the dry-cast method.
2. Units shall be resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.
3. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
4. Provide drips on projecting elements.

B. Colors and Textures: As selected by Designer from manufacturer's full range.

2.4 MORTAR MATERIALS:

A. Provide mortar materials that comply with CSI Division 04 Section 042000, "Unit Masonry."

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions, 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.

3.2 SETTING PRECAST WINDOW SILL IN MORTAR:

A. Install precast window sill units to comply with the requirements in CSI Division 04, Section 042000 "Unit Masonry."

B. Set precast window sill as indicated on plans. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
2. Coordinate installation of precast sill with installation of flashing specified in other Sections.

C. Wet joint surfaces thoroughly before applying mortar or setting in mortar.

D. Set units in full bed of mortar with full head joints unless otherwise indicated.

1. Set units with joints 1/4 to 3/8 inch (6 to 10 mm) wide.
2. Build anchors and ties into mortar joints as units are set.

E. Rake out joints for pointing with mortar to depths of not less than 3/4 inch (19 mm). Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.

F. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch (10 mm). Compact each layer thoroughly and allow it to become thumb-print hard before applying the next layer.

3.3 ADJUSTING AND CLEANING

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Precast window sill may be repaired if methods and results are approved by Designer.

B. Replace units in a manner that results in precast sill matching approved Samples, complying with other requirements, and showing no evidence of replacement.

C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed precast sill as follows:

1. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.

2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Engineer's approval of sample cleaning before proceeding with cleaning of precast window sill.
3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.

END OF SECTION 047200

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Structural Steel (W Shapes, Hollow Structural Sections, Angles, Channels, Plates)
2. Non-Shrink Grout
3. High-Strength Bolts, Nuts and Washers
4. Primer

B. Related CSI Sections include the following:

1. Division 05 Section 055000, "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame, miscellaneous steel fabrications and other metal items not defined as structural steel.
2. Division 09 painting Sections for surface preparation and priming requirements.

1.2 DEFINITIONS:

A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.3 PERFORMANCE REQUIREMENTS:

A. Connections: Provide details of connections required by the Contract to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC's "Manual of Steel Construction, Allowable Stress Design," Part 4.

B. Construction: Simple framing, partially restrained.

1.4 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length and type of each weld.
4. Indicate type, size and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.

D. Welding certificates.

E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

1. Structural Steel (W-Shapes, Hollow Structural Sections, Channels and Angles) including chemical and physical properties.
2. Bolts, nuts and washers including mechanical properties and chemical analysis.
3. Direct-tension indicators.
4. Tension-control, high-strength bolt-nut-washer assemblies.
5. Anchor rods
6. Anchor Rods or Bolts in chemical-anchoring material
7. Shop primers.
8. Non-shrink grout.

F. Source quality-control test reports.

1.5 QUALITY ASSURANCE:

A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE for Steel-Framed Buildings.

B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Building QMS Certification (BU).

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel."

1. Present evidence that each welder has satisfactory passed AWS qualification test for welding processes involved and, if pertinent, has undergone recertification.

E. Comply with applicable provisions of the following specifications and documents:

1. AISC, "Code of Standard Practice for Steel Buildings and Bridges."
2. AISC, "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2."
3. AISC, "Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design."
4. AISC, "Specification for the Design of Steel Hollow Structural Sections."
5. AISC, "Specification for Allowable Stress Design of Single-Angle Members."
6. RCSC, "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.6 DELIVERY, STORAGE AND HANDLING:

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
   1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use. If surfaces which are to be connected by field bolting or that are subject to field welding become rusted or contaminated with any foreign material that would make these connecting procedures unacceptable, the Contractor shall restore these surfaces at no additional cost to the State by scraping, grinding or wire brushing as necessary to remove all foreign material and rust that will interfere with welding and bolting.
   2. Do not store materials on structure in a manner that might cause distortion, damage or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 COORDINATION:

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS:

A. W-Shapes (Beams and Columns), Channels (Headers): ASTM A992 (50 ksi.)

B. Hollow Structural Sections, HSS, (Columns): ASTM A500, Grade C (50 ksi.)

C. Channels (Other than Headers), Angles and Plates: ASTM A 36.

D. Bars: ASTM A 36.

E. Steel Pipe: ASTM A 53, Type E, Grade B or ASTM A106

1. Weight Class: Standard.
2. Finish: Galvanized.

F. Medium-Strength Steel Castings: ASTM A 27, Grade 65-35, carbon steel.

G. Welding Electrodes: E-70 to comply with AWS requirements.

2.2 BOLTS, CONNECTORS AND ANCHORS:

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.
2. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type.

a. Finish: Plain.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy hex head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.

C. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.

D. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.

2.3 PRIMER:

A. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting.

B. Primer: Comply with performance requirements in SSPC-Paint Spec No. 20 Type II Zinc-Rich Organic

C. Use any of the following zinc-based products subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AkzoNobel; Devoe Coatings CATHACOAT 313 Organic Zinc Rich Primer
2. Cloverdale Paint; High Performance ClovaZinc 3 Epoxy Zinc Rich Primer
3. PPG Architectural Finishes, Inc.: Aquapon Zinc-rich Primer 97-670
4. Rust-Oleum; Rust O Zinc Organic Zinc Rich Primer
5. Tnemec Company, Inc.: Tnemec-Zinc 90-97

6. Sherwin-Williams Company: Corothane I GalvaPac Zinc Primer
7. Sherwin-Williams; Protective & Marine Zinc Clad IV

2.4 GROUT:

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, non-corrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION:

A. Structural Steel: Fabricate and assemble in shop to the fullest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design."

1. Camber structural-steel members where indicated.
2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Architecturally Exposed Structural Steel: Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel identified as architecturally-exposed structural steel.

1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names and roughness.
2. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating and shop priming.

C. Unless shown specifically in the structural drawings, design the connections in simply-supported beam spans to be able to carry one-half of the uniform load capacity of the beam at the specified span shown in the tables of Uniform Load Constants, in Part 2 of the AISC Manual of Steel construction (ASD)- 9th Edition. Do not use one-sided or other types of eccentric connections for the attachments of main structural members.

D. Thermal Cutting: Perform thermal cutting by machine to the fullest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

E. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

F. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

G. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10 inches o.c., unless otherwise indicated.

H. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.

1. Cut, drill or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Base-Plate Holes: Cut, drill, mechanically thermal cut or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS:

A. High-Strength Bolts: Shop-install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened and Slip critical.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance and quality of welds and for methods used in correcting welding work.

1. Remove backing bars or runoff tabs, back gouge and grind steel smooth.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
3. Verify that weld sizes, fabrication sequences and equipments used for architecturally-exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.

a. Grind butt welds flush.
b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

2.7 SHOP PRIMING:

A. Shop-prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials.
5. Galvanized surfaces.

B. Comply as specified in CSI Division 09 painting Sections. Shop-paint structural steel, except those members or portions of members to be embedded in concrete or mortar or scheduled to receive sprayed-on fireproofing. Paint embedded steel that is partially exposed on exposed portions and initial 2 inches of embedded areas only.

F. All structural steel except as indicated shall be shop-coated with any of the pre-approved zinc-based primer products as listed in this specification.

G. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." All fins, tears, slivers and burred or sharp edges that are present on any steel member or that appear during the blasting operation shall be removed by grinding and the area re-blasted to give a 2-3 mil surface profile.

H. Steel to steel contact surfaces welded in the shop shall be cleaned but not painted before welding occurs.

I. For all slip-critical connections used, the steel to steel contact surfaces shall not be painted.

J. Parts not in contact but inaccessible after assembly shall be painted before assembly with two coats of shop paint, the second coat to match the system of the finish painting of steel as specified in CSI Division 09 painting Sections. The colors shall be coordinated with approved submittals.

K. The ambient air and surface temperatures shall be at least 5°F above the dewpoint prior to and during coating applications.

2.8 GALVANIZING:

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.

1. Fill vent holes and grind smooth after galvanizing.
2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL:

A. The Engineer will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

2. Provide the Department 7 Calendar-day Notice for steel fabrication in Connecticut, and 10 Calendar-day Notice for all out-of-state fabrication.

B. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify elevations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates and other embedments, with steel erector present, for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Provide temporary shores, guys, braces and other supports during erection to keep structural steel secure, plumb and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections and bracing are in place, unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION:

A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design."

B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims or setting nuts as required.
2. Weld plate washers to top of base plate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and base plates to eliminate any voids. Neatly finish exposed surfaces, protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts**.**

C. Maintain erection tolerances of structural steel and architecturally-exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Remove erection bolts on architecturally-exposed structural steel. Fill holes with plug welds and grind smooth at exposed surfaces.

G. Do not use thermal cutting during erection.

H. Do not enlarge deficient holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS:

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened and Slip-critical, as indicated.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or run-off tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
4. Verify that weld sizes, fabrication sequences and equipments used for architecturally-exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.

   a. Grind butt welds flush.
   b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

3.5 FIELD QUALITY CONTROL:

A. Testing Agency: The Engineer will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:

   a. Liquid Penetrant Inspection: ASTM E 165.
   b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   c. Ultrasonic Inspection: ASTM E 164.
   d. Radiographic Inspection: ASTM E 94.

D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract.

3.6 REPAIRS AND PROTECTION:

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots and abraded surfaces of prime-painted joists and accessories, bearing plates and abutting structural steel.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

C. Touchup Painting: Cleaning and touchup painting are specified in CSI Division 09 painting Sections.

END OF SECTION 051200

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Long-span steel joists.
2. Joist accessories.

B. Related CSI Sections include the following:

1. Division 03 Section 033000, "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Division 04 Section 042000, "Unit Masonry" for installing bearing plates in unit masonry.
3. Division 09 painting Sections for finish painting of steel joists.

1.2 DEFINITIONS:

A. SJI "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support non-uniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.3 PERFORMANCE REQUIREMENTS:

A. Structural Performance: Provide special joists and connections capable of withstanding design loads within limits and under conditions indicated.

B. Design special joists to withstand design loads with live load deflections no greater than the following:

1. Roof Joists: Vertical deflection of 1/360 of the span.

1.4 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of joist, accessory and product indicated.

C. Working Drawings: Show layout, designation, number, type, location and spacing of joists. Include joining and anchorage details, bracing, bridging, joist accessories; splice and connection locations and details; and attachments to other construction.

1. Indicate locations and details of bearing plates to be embedded in other construction.
2. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

D. Quality Assurance Submittals:

1. Welding certificates. Copies of certificates for welding procedures and personnel.
2. Manufacturer Certificates: Signed by manufacturers certifying that joists comply with requirements.
3. Mill Certificates: Signed by bolt manufacturers certifying that bolts comply with requirements.
4. Qualification Data: For firms and persons specified in Part 1.5, "Quality Assurance" to demonstrate their capabilities and experience. Include list of completed projects with project names and addresses of architects and owners and other information specified.
5. Research/Evaluation Reports: Evidence of steel joists compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE:

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables of SJI "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
2. Professional Engineer Qualifications: A professional engineer licensed in the State of Connecticut and who is experienced in providing engineering services of the kind indicated.

B. SJI Specifications: Comply with standard specifications in SJI's "Specifications" that are applicable to types of joists indicated.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel.", and AWS D1.3”Structural Welding Code-Sheet Steel”.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Steel: Comply with SJI's "Specifications" for web and steel-angle chord members.

B. Steel Bearing Plates: ASTM A 36.

C. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Hot-dip zinc coating, ASTM A 153/A, Class C.

D. High-Strength Bolts, Nuts and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts; and hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating, ASTM A 153/A, Class C.

E. Welding Electrodes: Comply with AWS standards.

F. Galvanizing Repair Paint: ASTM A 780.

2.2 PRIMERS:

A. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting.

B. Primer: Comply with performance requirements in SSPC-Paint Spec No. 20 Type II Zinc-Rich Organic

C. Use any of the following zinc-based products subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AkzoNobel; Devoe Coatings CATHACOAT 313 Organic Zinc Rich Primer

2. Cloverdale Paint; High Performance ClovaZinc 3 Epoxy Zinc Rich Primer
3. PPG Architectural Finishes, Inc.: Aquapon Zinc-rich Primer 97-670
4. Rust-Oleum; Rust O Zinc Organic Zinc Rich Primer
5. Tnemec Company, Inc.: Tnemec-Zinc 90-97
6. Sherwin-Williams Company: Corothane I GalvaPac Zinc Primer
7. Sherwin-Williams; Protective & Marine Zinc Clad IV

2.3 LONG-SPAN STEEL JOISTS:

A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as follows:

1. Joist Type: LH-series steel joists.
2. End Arrangement: Underslung.
3. Top-Chord Arrangement: Parallel.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Camber long-span steel joists according to SJI's "Specifications".

2.4 JOIST ACCESSORIES:

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Steel bearing plates with integral anchorages are specified in CSI Division 05 Section 055000, "Metal Fabrications."

C. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.5 CLEANING AND SHOP PAINTING:

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2.

B. Apply 1 coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

C. Shop priming of joists and joist accessories is specified in CSI Division 09 painting Sections.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads have been applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL:

A. Testing Agency: The Contractor will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following procedures, as applicable:

1. Radiographic Testing: ASTM E 94.
2. Magnetic Particle Inspection: ASTM E 709.
3. Ultrasonic Testing: ASTM E 164.
4. Liquid Penetrant Inspection: ASTM E 165.

C. Bolted connections will be visually inspected.

D. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."

E. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

F. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION:

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, abutting structural steel, and accessories.

1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

C. Touchup Painting: Cleaning and touchup painting are specified in CSI Division 09 painting Sections.

D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure that joists and accessories are without damage or deterioration at time of the issuance of the Certificate of Compliance.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Metal Roof Deck.

B. Related CSI Sections include the following:

1. Division 05 Section 055000, "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Product Data: For each type of deck, accessory and product indicated.

C. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories and attachments to other construction.

D. Quality Assurance Submittals:

1. Product Certificates: For each type of steel deck, signed by product manufacturer.
2. Welding certificates.
3. Field quality-control test and inspection reports.
4. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements: Power-actuated mechanical fasteners.
5. Research/Evaluation Reports: Evidence of steel deck's compliance with building code in effect for the Project.

1.3 QUALITY ASSURANCE:

A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

B. Installer Qualifications: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful service and performance.

C. Welding: Qualify procedures and personnel according to AWS D1.1, “Structural Welding Code-Steel and AWS D1.3, "Structural Welding Code - Sheet Steel."

D. AISI Specifications: Calculate structural characteristics of steel deck according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members."

E. FMG Listing: Provide steel roof deck evaluated by FMG and listed in FMG’s "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1.5 COORDINATION:

A. Coordinate installation of sound-absorbing insulation strips in topside ribs of acoustical deck with roofing installation specified in CSI Division 07 to ensure protection of insulation strips against damage from effects of weather and other causes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Steel Deck:

a. BHP Steel Building Products USA Inc.
b. Canam Steel Corp.; The Canam Manac Group.
c. Consolidated Systems, Inc.
d. DACS, Inc.
e. D-Mac Industries Inc.
f. Epic Metals Corporation.
g. Marlyn Steel Decks, Inc.

h. Nucor Corp.; Vulcraft Division.
i. Roof Deck, Inc.
j. United Steel Deck, Inc.

2.2 ROOF DECK:

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:

1. Galvanized Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 33, G90 zinc coating.
2. Deck Profile: Type B, wide rib
3. Profile Depth: 1 ½”
4. Design Uncoated-Steel Thickness: 18 Gauge (0.0474 in.)
5. Yield Strength: 33 ksi minimum
6. Span Condition: As indicated on plans. The location of support for the steel roof deck should not be greater than that indicated on plans. The indicated spans are measured center-to-center. The deflection limitation for the steel roof deck should not exceed L/240.
7. Side Laps: Overlapped.

B. The steel roof deck should be FM Global-Approved.

2.3 ACCESSORIES:

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, (3)- No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch designs uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

G. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

H. Galvanizing Repair Paint: ASTM A 780.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL:

A. The steel deck should be installed per its FM Approval listing and the FM Global Property Loss Prevention Data Sheet 1-29, Roof Deck Securement and Above-Deck Roof Components.

B. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions and requirements in this Section.

C. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

D. Locate deck bundles to prevent overloading of supporting members.

E. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

F. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

G. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

H. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck and support of other work. The metal decking shall be trimmed out by the decking Contractor to eliminate rough edges.

I. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds and methods used for correcting welding work.

J. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION:

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing: a 36/7 fastening pattern. The weld should be spaced at a maximum spacing of 6 inches on center (every rib) in the field, and at all supports, corners and perimeter.
3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches, and as follows:

1. Mechanically fasten with self-drilling, (3)- No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch- long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches , with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

D. Uplift Loading: Install and anchor roof deck units to resist gross uplift loading of 15 psf at eave overhang and 10 psf for other roof areas.

E. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space more than 12 inches apart with at least one weld at each corner.

F. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

G. Flexible Closure Strips: Install flexible closure strips over partitions, walls and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY CONTROL:

A. Testing Agency: The Engineer will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Engineer.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS AND PROTECTION:

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds and abraded areas of both deck surfaces are included in CSI Division 09.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of the issuance of the Certificate of Compliance.

END OF SECTION 053100

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Loose bearing and leveling plates.
4. Steel weld plates and angles for casting into concrete not specified in other Sections.
5. Structural-steel door frames.
6. Miscellaneous steel trim including steel angle corner guards.
7. Metal ladders.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related CSI Sections include the following:

1. Division 03 Section 033000, "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, wedge-type inserts and other items indicated to be cast into concrete.
2. Division 04 Section 042000, "Unit Masonry" for installing loose lintels, anchor bolts and other items indicated to be built into unit masonry.
3. Division 05 Section 051200, "Structural Steel Framing."
4. Division 06 Section 061000, "Rough Carpentry" for metal framing anchors.

1.2 PERFORMANCE REQUIREMENTS:

A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections and other detrimental effects. Base engineering

calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR-SUBMITTALS.

B. Product Data: For the following:

1. Paint products.
2. Grout.
3. Ladders.
4. Post-installed Anchors.
5. Materials used in miscellaneous metal fabrications.

C. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.
3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Quality Assurance Submittals

1. Welding Certificates.
2. Qualification Data: For Professional Engineer.

E. Conduct a Coordination Meeting at the Project Site in compliance with the requirements of Form 818 Article 1.20-1.05.24, subsection 4.

1. Meet with Designer, Engineer, Contractor, related subcontractors, and all applicable Contractor submittal preparers well in advance of the commencement of submittal preparation.
2. Discuss any Contractor concerns prior to submission of RFI's.
3. Review Contract requirements including clarification of the scope of work, tolerances, layouts and sequences, and special considerations.
4. Review detailing and coordination requirements such as bolting, welding, and connection considerations, constructability considerations, OSHA requirements, coordination with other trades, and the availability of materials.
5. Review the anticipated submittal schedule, identifying critical deadlines to avoid manufacturing delays.
6. Review of quality, testing, certifications, and inspection requirements, including the approval process for corrective work.

1.4 QUALITY ASSURANCE:

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. AWS D1.6, "Structural Welding Code--Stainless Steel."
5. Certify that each welder has satisfactory passed AWS qualification test for welding process involved and, if pertinent, has undergone recertification.

1.5 PROJECT CONDITIONS:

A. Field Measurements: The Contractor shall verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.6 COORDINATION:

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts and items with integral anchors that are to be embedded in concrete or masonry. Deliver such items to Project Site in time for installation.

B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project Site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. In other portions of Part 2 where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 METALS, GENERAL:

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names or blemishes.

2.3 FERROUS METALS:

A. Steel Plates, Shapes and Bars: ASTM A 36.

B. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

2.4 FASTENERS:

A. General: Unless otherwise indicated, provide Type 304 and Type 316 for corrosive environment, stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36

1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

D. Eyebolts: ASTM A 489

E. Machine Screws: ASME B18.6.3

F. Lag Bolts: ASME B18.2.1

G. Wood Screws: Flat head, ASME B18.6.1

H. Plain Washers: Round, ASME B18.22.1

I. Lock Washers: Helical, spring type, ASME B18.21.1

J. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers and shims as needed, hot-dip galvanized per ASTM A 153.

K. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material for Anchors in Exterior Locations: Alloy Group 1 (A1) or 2 (A4) stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

2.5 MISCELLANEOUS MATERIALS:

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting. Primer: Comply with performance requirements in SSPC-Paint Spec No. 20 Type II Zinc-Rich Organic

1. Use any of the following zinc-based products subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AkzoNobel; Devoe Coatings CATHACOAT 313 Organic Zinc Rich Primer
   b. Cloverdale Paint; High Performance ClovaZinc 3 Epoxy Zinc Rich Primer
   c. PPG Architectural Finishes, Inc.: Aquapon Zinc-rich Primer 97-670
   d. Rust-Oleum; Rust O Zinc Organic Zinc Rich Primer
   e. Tnemec Company, Inc.: Tnemec-Zinc 90-97
   f. Sherwin-Williams Company: Corothane I GalvaPac Zinc Primer
   g. Sherwin-Williams; Protective & Marine Zinc Clad IV

C. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

E. Non-shrink, Non-metallic Grout: Factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

F. Concrete Materials and Properties: Comply with requirements in CSI Division 03 Section 033000, "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix

concrete with a minimum 28-day compressive strength of 4000 psi, unless otherwise indicated.

2.6 FABRICATION, GENERAL:

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural strength and integrity of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion-resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and the contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill and tap metal fabrications as indicated to receive finish hardware, screws and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints,

overstressing of components, failure of connections and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 F, material surfaces.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS:

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill and tap units to receive hardware, hangers and similar items.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts if units are to be installed after concrete is placed.

C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.

1. Provide bearing plates welded to beams where indicated.
2. Drill girders and plates for field-bolted connections where indicated.
3. Where wood nailers are attached to girders with bolts or lag screws, drill holes at 24 inches o.c. unless noted otherwise for a closer spacing.

D. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel base plates and top plates as indicated. Drill base plates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness, unless otherwise indicated.

1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
2. Unless otherwise indicated, provide 1/2-inch base plates with four 5/8-inch anchor bolts and 1/4-inch top plates.

E. Galvanize miscellaneous framing and supports where indicated.

2.8 LOOSE STEEL LINTELS:

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

2.9 LOOSE BEARING AND LEVELING PLATES:

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates after fabrication.

2.10 STEEL WELD PLATES AND ANGLES:

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

2.11 MISCELLANEOUS STEEL TRIM:

A. Unless otherwise indicated, fabricate units from steel shapes, plates and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim and interior miscellaneous steel trim, where indicated.

2.12 METAL LADDERS:

A. General:

1. Comply with ANSI A14.3, and the latest OSHA Safety Requirements, unless otherwise indicated in the Contract Drawings.
2. Space side-rails 24 inches apart, unless otherwise indicated.
3. Support each ladder at top and bottom and not more than 48 inches on centers with welded or bolted brackets, made from same metal as ladder to comply with the requirements of ANSI A14.3 and all manufacturer's recommendations.

B. Metal Ladders:

1. Side-rails: Continuous channels or tubes, not less than 2-1/2 inches deep, 3/4 inch wide, and 1/8 inch thick.

2. Rungs: Tubes, not less than 3/4 inch deep and not less than 1/8 inch thick, with ribbed tread surfaces.
3. Landing Platform: Welded or pressure-locked steel bar gratings, supported adequately by appurtenant steel members such as steel angles or channels. The openings or spaces in the gratings must not exceed ½ inch.
4. Fit rungs in centerline of side-rails; fasten by welding or with stainless-steel fasteners or brackets.

2.13 METAL LADDER SAFETY CAGES:

A. General:

1. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
2. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet o.c. Provide secondary intermediate hoops spaced not more than 48 inches o.c. between primary hoops.
3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless-steel fasteners, unless otherwise indicated.

B. Ladder Safety Cages:

1. Primary Hoops: 1/4-by-4-inch flat bar hoops.
2. Secondary Intermediate Hoops: 1/4-by-2-inch flat bar hoops.
3. Vertical Bars: 1/4-by-2-inch flat bars secured to each hoop.

2.14 FINISHES, GENERAL:

A. Comply with CSI Division 09 painting Sections.

B. Finish metal fabrications after assembly.

2.15 STEEL AND IRON FINISHES:

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123, for galvanizing steel and iron products.
2. ASTM A 153, for galvanizing steel and iron hardware.

B. Preparation for Shop Priming: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." All fins, tears, slivers and burred or sharp edges that are present on any steel member or that appear during the

blasting operation, shall be removed by grinding and the area re-blasted to give a 2-3 mil surface profile.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

A. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood or dissimilar metals with a heavy coat of bituminous paint.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS:

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in Part 3.3 "Installing Bearing and Leveling Plates".

D. Install pipe columns on concrete footings with grouted base plates. Position and grout column base plates as specified in Part 3.3 "Installing Bearing and Leveling Plates".

1. Grout base plates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING BEARING AND LEVELING PLATES:

A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use non-shrink, non-metallic grout in exposed locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING:

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots and abraded surfaces of prime-painted joists and accessories**,** bearing plates and abutting structural steel.
1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

C. Finish Painting: Comply with CSI Division 09 painting Sections.

D. Galvanized Surfaces: Clean field welds, bolted connections and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Framing with dimension lumber.
2. Wood blocking, cants, and nailers.
3. Electrical panel backer boards.

1.2 DEFINITIONS:

A. Exposed Framing: Framing not concealed by other construction.

B. Dimension Lumber: Lumber of 2 inches nominal or greater, but less than 5 inches nominal in least dimension.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. SPIB: Southern Pine Inspection Bureau.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated the materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. Fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

C. Fastener Schedule: Include the following information:

1. Fastener application, location, and designation.
2. Fastener manufacturer and product name.

D. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

E. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Wood-preservative-treated wood.
2. Engineered wood products.
3. Fire-retardant-treated wood
4. Power-driven fasteners.
5. Powder-actuated fasteners.
6. Metal framing anchors.

1.4 QUALITY ASSURANCE:

A. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria":

1. Dimension lumber framing.
2. Laminated veneer lumber.
3. Rim boards.
4. Miscellaneous lumber.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL:

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory-mark each piece of lumber with grade-stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER:

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground; Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat all rough carpentry items, unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS:

A. General: Comply with performance requirements in AWPA U1.

1. Use Exterior type for exterior locations and where indicated.

2. Use Interior Type A, High Temperature (HT) for enclosed roof framing, framing in attic spaces, and where indicated.
3. Use Interior Type A, unless otherwise indicated.

B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marling and provide certificates of treatment compliance issued by inspection agency.

C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

D. Application: Treat the following:

1. Concealed blocking.
2. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING:

A. Maximum Moisture Content: 15 percent for 2-inch nominal thickness or less, and 19 percent for more than 2-inch nominal thickness.

B. Wall Framing, Roof Framing, Roof Blocking and Truss Members: Southern Pine of No.1, No. 2 or better grade, with minimum Allowable Stress Capacities and Modulus of Elasticity as indicated on the plans.

2.5 MISCELLANEOUS LUMBER:

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Nailers: Provide drawings to confirm that wood nailers are secured per FM Global Property Loss Prevention Data Sheet 1-49, *Perimeter Flashing.*
2. Rooftop equipment bases and support curbs.
3. Cants.
4. Furring.
5. Grounds.

B. For blocking not used for attachment of other construction. Southern Pine of No. 1, No. 2 or better grade, with minimum Allowable Stress Capacities and Modulus of Elasticity as indicated on the plans.

C. For items of dimension lumber, provide Southern Pine, No.1 grade, with 15 percent maximum moisture content.

D. For blocking and nailer used for attachment of other construction. Select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.6 PLYWOOD BACKING PANELS:

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.7 FASTENERS:

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.8 MISCELLANEOUS MATERIALS:

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

B. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1 "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Do not splice structural members between supports, unless otherwise indicated.

D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

E. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities.

F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. ICC-ES AC70 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

I. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive

finish materials. Make tight connections between members. Install fasteners without splitting wood. Do not countersink nail heads, unless otherwise indicated.

J. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION:

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION:

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.4 PROTECTION:

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Wall sheathing.

B. Related CSI Sections include the following:

1. Division 06 Section 061000, "Rough Carpentry."

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR-SUBMITTALS.

B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.

3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.

1.3 QUALITY ASSURANCE:

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

B. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria":

1. Plywood.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS, GENERAL:

A. Plywood: DOC PS 1.

B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE-TREATED PLYWOOD:

A. Preservative Treatment by Pressure Process: AWPA U1.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat all plywood, unless otherwise indicated.

2.3 WALL SHEATHING:

A. Plywood Wall Sheathing: Exposure 1 sheathing.

1. Span Rating: Not less than 24/0.

2.4 FASTENERS:

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153 or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener system with an evaluation report acceptable to authorities to having jurisdiction, based on IIC-ES AC70.

D. Wood Screws: ASME B18.6.1.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.

2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."

D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION:

A. General: Comply with applicable recommendations in APA Form No. E30S, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall Sheathing:

a. Nail to wood framing.
b. Space panels 1/8 inch apart at edges and ends.

END OF SECTION 061600

SECTION 068200 – FIBERGLASS REINFORCED PLASTIC PRODUCTS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Glass-fiber-reinforced-plastic gratings.
2. Glass-fiber-reinforced-plastic frames and supports.
3. Glass-fiber-reinforced-plastic railings.

B. Related CSI Sections include the following:

1. Division 03 Section 033000 – Cast-In-Place Concrete for concrete slab and for anchoring glass-fiber-reinforced plastic grated stairs, landing and catwalk.

1.2 COORDINATION:

A. Coordinate installation of anchorages for gratings, grating frames, and posts. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete. Specify the required footing sizes under all posts. Deliver such items to Project site in time for installation.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following:

1. Glass-fiber-reinforced-plastic gratings.
2. Glass-fiber-reinforced-plastic railings.
3. Railing brackets.

C. Working Drawings of structural members, standard railing, grating and treads shall be submitted to the Engineer for approval. Working Drawings shall include, but not limited to the following:

1. Plans, elevations, sections, details, with dimensions of stair, railings, grating, footings, structural members and attachments to other work.
2. Size and type of supporting frames or framework required.

D. Samples for Verification: For the following products:

1. Molded glass-fiber-reinforced-plastic gratings.
2. Glass-fiber-reinforced-plastic railings and posts.
3. Glass-fiber-reinforced-plastic frames and supports.

E. Delegated-Design Submittal: For footings, gratings, stairs and railings, including analysis data signed and sealed by the qualified Professional Engineer registered to practice in the State of Connecticut who shall be responsible for the structural design and working drawings.

F. Quality Assurance Submittals

1. Regulatory Requirements: Comply with OSHA Standards.
2. Installer Qualification: Fabricator of products.

1.4 FIELD CONDITIONS:

A. Field Measurements: Verify actual locations of walls and other construction contiguous with primary and secondary structural supports, gratings and railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. Structural Performance: Gratings shall withstand the effects of gravity live loads and the following loads and stresses within limits and under conditions indicated:

1. Stairs and Floors: Uniform load of 100 lb/sq. ft. or concentrated load of 3000 lbs, whichever produces the greater stress.
2. Walkways and Elevated Platforms Other Than Exits: Uniform load of 100 lb/sq ft or concentrated load of 3000 lbs.

3. Limit deflection to L/180 or 1/4 inch, whichever is less.

B. Attachments

1. Attachment accessories, support brackets, angles, anchor bolts and mounting bolts shall be ANSI Type 316 stainless steel, fiber glass, or provide a zinc coating.

C. Seismic Performance: Gratings and railings and all primary and secondary structural support systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.5.

2.2 GLASS-FIBER-REINFORCED-PLASTIC GRATINGS:

A. Molded Glass-Fiber-Reinforced-Plastic Gratings: Bar gratings made by placing glass-fiber strands that have been saturated with thermosetting plastic resin in molds in alternating directions to form interlocking bars without voids and with a high resin content.

1. Basis of Design: DURAGRATE® as manufactured by Strongwell or approved equal.
2. Configuration: As required to comply with structural performance requirements.

3. Resin: Polyester with a UV inhibitor.

   a. Flame-Spread Index: 25 or less when tested according to ASTM E 84.
   b. USDA Acceptance: Accepted for food-processing applications.

4. Color: Manufacturer's standard Yellow.
5. Traffic Surface: Applied abrasive finish.

2.3 STRUCTURAL SHAPES AND PLATE:

A. Pultruded Glass-Fiber-Reinforced-Plastic Shapes: Assembled from components made by simultaneously pulling glass fibers and extruding thermosetting plastic resin through a heated die under pressure to produce a product without voids and with a high fiber content. Plate shall be 1 inch in thickness.

1. Basis of Design: Series 500/525 shapes as manufactured by Strongwell or approved equal.
2. Resin: Polyester with a UV inhibitor.

   a. Flame-Spread Index: 25 or less when tested according to ASTM E 84.
   b. USDA Acceptance: Accepted for food-processing applications.

3. Color: Manufacturer's standard Gray.

2.4 GRATING FRAMES AND SUPPORTS:

A. General: Fabricate from glass-fiber-reinforced-plastic shapes of sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, use shapes made from same resin as gratings.
2. Equip units indicated to be cast into concrete with integral anchors.
3. Resin: Polyester with a UV inhibitor.

   a. Flame-Spread Index: 25 or less when tested according to ASTM E 84.
   b. USDA Acceptance: Accepted for food-processing applications.

4. Color: Manufacturer's standard Gray.

2.5 RAILINGS:

A. General: The rails and posts shall be 2 inch by 2 inch x 0.156 inch square tube handrail system manufactured by the pultrusion process. If pickets are required, they are to be a minimum of 1 inch square tube.

1. Basis of Design: SAFRAIL® as manufactured by Strongwell.

B. Resin: Polyester with a UV inhibitor.

1. Coating: Industrial grade polyurethane coating for additional UV protection and wear resistance, with minimum thickness of 1 mil.
2. Flame-Spread Index: 25 or less when tested according to ASTM E 84.

C. Color: Manufacturer's standard Yellow.

2.6 FASTENERS:

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts.

D. Post-Installed Anchors: Chemical anchors (Hilti HIT-HY 200 or an approved equal) capable of sustaining, without failure, a load equal to four times the load imposed when installed in concrete, for gravity and lateral loads, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.7 MISCELLANEOUS MATERIALS:

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications, with a minimum compressive strength of 3,000 psi.

2.8 FABRICATION:

A. Shop Assembly: Shop fabricate grating sections to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form gratings from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form joints.

E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

F. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

G. After fabrication, all cut ends, holes and abrasions of glass-fiber-reinforced-plastic products shall be sealed with a compatible resin coating to prevent intrusion of moisture.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing fiberglass stairs to in-place construction. Include threaded fasteners for concrete inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing fiberglass stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete.

D. Fit exposed connections accurately together to form joints.

3.2 INSTALLING GLASS-FIBER-REINFORCE-PLASTIC GRATINGS:

A. Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard stainless-steel anchor clips and hold-down devices for bolted connections.

3.3 INSTALLING STAIRS AND LANDING PLATFORM WITH GROUTED BASEPLATES:

A. Clean concrete bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonmetallic, nonshrink 3,000 psi grout unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

END OF SECTION 068200

SECTION 071113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Cold-applied, emulsified-asphalt dampproofing.
2. Protection board insulation.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

C. Quality Assurance Submittals:

1. Material Certificates: For each product, signed by manufacturers.
2. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.3 QUALITY ASSURANCE:

A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.4 PROJECT CONDITIONS:

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Henry Company.
2. Karnak Corporation.
3. Meadows, W. R., Inc.

B. Trowel Coats: ASTM D 1227, Type II, Class 1.

C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.

D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

E. VOC Content: Zero, 0.25 lb/gal..

2.2 PROTECTION COURSE:

A. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on one side with plastic film, nominal thickness 1/4 inch with a compressive strength of not less than 8 psi per ASTM D 1621 and maximum water absorption by volume of 0.6 percent per ASTM C 272.

2.3 MISCELLANEOUS MATERIALS:

A. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.

B. Glass Fabric:

1. Asphalt-coated: ASTM D 1668, Type I.
2. Uncoated: ASTM D 1668, Type III.

C. Patching Compound: Manufacturer's fibered mastic of type recommended by dampproofing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, with Installer present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.

1. Proceed with dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.
2. Test for surface moisture according to ASTM D 4263.

3.2 PREPARATION:

A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

C. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.3 APPLICATION, GENERAL:

A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.

1. Apply additional coats if recommended by manufacturer or if required to achieve coverages indicated.
2. Allow each coat of dampproofing to cure six hours before applying subsequent coats.
3. Allow 24 hours drying time prior to backfilling.

B. Apply dampproofing to footings and foundation walls where opposite side of wall faces building interior.

1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches over outside face of footing.
2. Extend 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.

3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

C. Apply dampproofing to provide continuous plane of protection on exterior face of inner wythe of exterior masonry cavity walls.

1. Lap dampproofing at least 1/4 inch onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
2. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe, and lap dampproofing at least 1/4 inch onto shelf angles supporting veneer.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING:

A. On Concrete Foundations: Apply 2 brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat, 1 fibered brush or spray coat at not less than 3 gal./100 sq. ft., or 1 trowel coat at not less than 4 gal./100 sq. ft..

B. On Exterior Face of Inner Wythe of Cavity Walls: Apply primer and 1 brush or spray coat at not less than 1 gal./100 sq. ft..

3.5 INSTALLATION OF PROTECTION COURSE:

A. Install protection course over completed-and-cured dampproofing. Comply with dampproofing material manufacturer's written recommendations for attaching protection course.

1. Support protection course with spot application of adhesive of type recommended by protection board manufacturer over cured coating.
2. Install protection course within 24 hours of installation of dampproofing (while coating is tacky) to ensure adhesion.

3.6 CLEANING:

A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION 071113

SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes penetrating and water-repellent coatings for the following vertical and horizontal surfaces:

1. Wash Bay concrete slab.
2. Bay Areas concrete slab.
3. Exterior Brick.
4. Exterior Concrete pads including, but not limited to the following: fuel facility slabs, oil-water separator slab, generator slab, transformer pad, concrete sidewalk, sanitary pump station, and salt shed loading dock.

B. Related CSI Sections include the following:

1. Division 03 Section 033000, "Cast-in-Place Concrete" for curing and sealing compounds, and penetrating liquid floor treatments.
2. Division 04 Section 042000, "Unit Masonry" for integral water-repellent admixture for unit masonry assemblies.

1.2 PERFORMANCE REQUIREMENTS:

A. Performance Testing: Provide water repellents that comply with test-performance requirements indicated, as evidenced by reports of tests performed by manufacturer by a qualified independent testing agency on manufacturer's standard products applied to substrates simulating those on Project using same application methods to be used for Project.

1. Engage testing agency to perform preconstruction tests on laboratory mockups.
2. Select sizes and configurations of assemblies to adequately demonstrate capability of water repellents to comply with performance requirements.
3. Notify Engineer seven calendar days in advance of the dates and times when assemblies will be constructed.

B. Absorption: Minimum 90 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.

1. Concrete Unit Masonry: ASTM C 140.
2. Hardened Concrete: ASTM C 642.

C. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.

D. Permeability: Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, per ASTM D 1653.

E. Water Penetration and Leakage through Masonry: Maximum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E 514.

F. Durability: Maximum 5 percent loss of water repellency after 2500 hours of weathering in comparison to specimens before weathering, per ASTM G 154.

G. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.

1. Reduction of Water Absorption: 80 percent.
2. Reduction in Chloride Content: 80 percent.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Include manufacturer's printed statement of VOC content.
2. Include manufacturer's standard colors.

C. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

D. Manufacturer Certificates: Signed by manufacturers certifying that water repellents comply with requirements.

E. Qualification Data: For Installer.

F. Preconstruction Testing Reports: For water-repellent-treated substrates.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for assemblies.

1.4 QUALITY ASSURANCE:

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 548 for testing indicated.

C. Test Application: Apply a finish sample for each type of water repellent and substrate required. Duplicate finish of approved sample.

1. Locate each test application as directed by the Engineer.
2. Size: 25 sq. ft.
3. Final approval by Engineer of water-repellent application will be from test applications.

1.5 PROJECT CONDITIONS:

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:

1. Ambient temperature is above 40 deg F.
2. Concrete surfaces and mortar have cured for more than 28 days.
3. Concrete or brick masonry walls are not treated prior to 30 days after building close-in.
4. Rain or snow is not predicted within 24 hours.
5. Application proceeds more than 24 hours after surfaces have been wet.
6. Substrate is not frozen, or surface temperature is above 40 deg F.
7. Windy conditions do not exist that may cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

PART 2 - PRODUCTS

2.1 PENETRATING WATER REPELLENTS:

A. Silane, Penetrating Water Repellent (Floors in Wash Bay Area, Bay Areas, Existing Bay Area, and unpainted exterior concrete unit masonry walls): Clear, monomeric compound containing 20 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 3 lb/gal.or less of VOCs.

B. Penetrating Salt and Water Repellent (Exterior Concrete pads): Clear, silane and siloxane blend containing 4 percent or more solids; with alcohol, ethanol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.

1. Basis of Design Product: Saltguard WB as manufactured by Prosoco, or an approved equal.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to water-repellent manufacturer's written instructions, to ensure that surface is dry enough.

1. Cast-in-Place Concrete and Concrete Masonry Units: Remove oil, curing compounds, laitance, and other substances that could prevent adhesion or penetration of water repellents.
2. Concrete Slabs: Prepare slabs per manufacturer’s recommended installation procedure.

B. Test for pH level, according to water-repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.

C. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.

D. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION:

A. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.

B. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.3 CLEANING:

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Perimeter insulation under slabs-on-grade.
2. Cavity-wall insulation.

B. Related CSI Sections include the following:

1. Division 04 Section 042000, "Unit Masonry" for insulation installed in cavity walls and masonry cells.
2. Division 07 Section 075419, “Polyvinyl-Chloride (PVC) Roofing” for insulation specified as part of roofing construction.
3. Division 07 Section 078446, "Fire-Resistive Joint Systems" for insulation installed as part of a perimeter fire-resistive joint system.
4. Division 22 insulation sections.
5. Division 23 insulation sections.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS

D. Research/Evaluation Reports: For foam-plastic insulation.

1.3 QUALITY ASSURANCE:

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products

per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. In other portions of Part 2 where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufactures: Subject to compliance with requirements, manufactures offering products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 FOAM-PLASTIC BOARD INSULATION:

A. Foil-Faced, Polyisocyanurate Board Insulation (cavity wall insulation): ASTM C 1289, Type I, Class 1 with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

B. Available Manufacturers:

1. Atlas Roofing Corporation.
2. Dow Chemical Company (The).
3. Rmax, Inc.
4. Johns Manville

C. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

1. Available Manufacturers:

a. DiversiFoam Products.
b. Dow Chemical Company (The).
c. Owens Corning.

2. Type X, 15 psi (104 kPa).

D. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.3 INSULATION FASTENERS:

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:

1. Available Manufactures:

a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
b. Eckel Industries of Canada; Stic-Klip Type N Fasteners.
c. Gemco; Spindle Type.

2. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
3. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.

1. Available Products:

a. AGM Industries, Inc.; RC150.
b. AGM Industries, Inc.; SC150.
c. Gemco; Dome-Cap.
d. Gemco; R-150.

e. Gemco; S-150.

C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

1. Available Products:

a. AGM Industries, Inc.; TACTOO Adhesive.
b. Eckel Industries of Canada; Stic-Klip Type S Adhesive.
c. Gemco; Tuff Bond Hanger Adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL:

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of

insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF UNDER-SLAB INSULATION:

A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

C. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.

D. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.5 INSTALLATION OF CAVITY-WALL INSULATION:

A. On units of foam-plastic board insulation, install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates indicated.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in CSI Division 04 Section 042000, "Unit Masonry."

3.6 INSTALLATION OF GENERAL BUILDING INSULATION:

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Set vapor-retarder-faced units with vapor retarder to warm-in-winter side in location indicated of construction, unless otherwise indicated.

1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

3.7 INSTALLATION OF VAPOR RETARDERS:

A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Firmly attach vapor retarders to solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.

C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.

D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.8 PROTECTION:

A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 074213 - METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Concealed-fastener, lap-seam metal wall panels.

B. Related CSI Sections:

1. Division 07 Section 076200, "Sheet Metal Flashing and Trim" for flashing and other sheet metal work that is not part of metal wall panel assemblies.

1.2 PREINSTALLATION MEETINGS:

A. Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 818 Article 1.20-1.05.24 subsection 2.

1. Meet with Owner, Designer, Owner's insurer if applicable, metal wall panel Installer, metal wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal wall panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings and condition of other construction that affects metal wall panels.
6. Review governing regulations and requirements for insurance, certificates, test and inspections if applicable.
7. Review temporary protection requirements for metal wall panel assembly during and after installation.
8. Review repair procedures for metal wall panels damaged after installation.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of wall panel and accessory.

C. Working Drawings: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory-, shop- and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):

a. Flashing and trim.
b. Anchorage systems.

D. Samples for Verification:

1. (2) 6 X 12 inch sections of insulated wall panel, of exterior and interior finish specified and with the interlocking profile at one long edge each.
2. Physical color palette of manufacturer's full range of colors.

E. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

F. Qualification Data: For Installer.

G. Material Certificates:

1. For thermal insulation, signed by manufacturers.
2. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq.ft. of wall area when tested according to ASTM E 283.

H. Maintenance Data: For metal wall panels to include in maintenance manuals to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

I. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE:

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

C. Source Limitations: Obtain each type of metal wall panel from single source from single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.

B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

1.6 PROJECT CONDITIONS:

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.

1.7 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Manufacturer's standard, but not less than 5-years from the issuance of the Certificate of Compliance.

C. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish Warranty Period: 25 years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. General Performance: Metal wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Design metal wall panel assembly, including comprehensive engineering analysis signed and sealed by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

D. Water Penetration under Dynamic Pressure: No evidence of water leakage when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. and not more than 12 lbf/sq. ft.

1. Water Leakage: Uncontrolled water infiltrating the system or appearing on system's normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.

E. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:

1. Wind Pressures: Refer to Structural Drawings.
2. Deflection Limits: Metal wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/180 of the span.

F. FM Global Listing: Metal Wall Panels shall comply with the following design requirements:

1. Fire/Windstorm Classification: Class 1A-105.
2. Hail-Resistance Rating: MH.
3. Approval Category for Wind Zone: HM-SM (hurricane-prone region with small debris impact).
4. Design Loads: Refer to Structural Drawings.

5. Factor of Safety: 2.0.
6. FM Global Data Sheet 1-28 Wind Design.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 PANEL MATERIALS:

A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
3. Surface: Embossed finish.
4. Exposed Coil-Coated Finish
5. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

B. Panel Sealants:

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.3 MISCELLANEOUS METAL FRAMING:

A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanizedcoating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum –zinc alloy coating

designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Subgirts: Manufacturer's standard C- or Z-shaped sections, 0.064-inch nominal thickness.

C. Zee Clips: 0.079-inch nominal thickness.

D. Base or Sill Angles: 0.079-inch nominal thickness.

E. Cold-Rolled Furring Channels: Minimum 1/2-inch wide flange.

1. Depth: 3/4 inch.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with 0.040-inch nominal thickness.
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch diameter wire, or double strand of 0.048-inch diameter wire.

F. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, and depth required to fit insulation thickness indicated.

G. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

2.4 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS:

A. General: Provide factory-formed metal wall panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.

B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced, flat pan between panel edges; with flush joint between panels.

1. Panel Material and Finish:

a. Exterior Face: Corrugated 24 ga. (0.0239 inches) min. Zinc-coated (galvanized) steel sheet.
b. Exterior Profile: Textured profile.
c. Exterior Finish: 2-coat fluoropolymer Kynar 500 finish.
d. Exterior Color: Tan.
e. Interior Face: 26 ga. (0.0179 inches) Zinc-coated (galvanized) steel sheet.
f. Interior Profile: Minor ribs.
g. Interior Color: Imperial White.

2. Panel Thickness: 3 inches.
3. Panel Coverage: 36 inches.
4. Minimum Thermal-Resistance Value (R-Value): R-22.
5. Polyurethane foam core insulation.

2.5 MISCELLANEOUS MATERIALS:

A. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal wall panels.
2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. Flashing and Trim: Formed from 0.018-inch minimum thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fascia, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

C. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

D. Fillable Materials: Two-part urethane foam insulation injected into cut openings. Allow to cure before covering with flashing.

2.6 FABRICATION:

A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal wall panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, and that will minimize noise from movements within panel assembly.

E. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.

B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Miscellaneous Framing: Install subframing, subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorages according to

ASTM C 754 and metal wall panel manufacturer's written recommendations. Install non-structural stiffening member, provided by manufacturer at the expansion joint. Color to match the interior panel color.

3.3 METAL WALL PANEL INSTALLATION:

A. General: Install metal wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on the plans. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal wall panels by torch in not permitted.
2. Commence metal wall panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
3. Shim or otherwise plumb substrates receiving metal wall panels.
4. Flash and seal metal wall panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall panels are installed.
5. Install screw fasteners in predrilled holes.
6. Apply butyl caulk under flashing to prevent air infiltration.
7. Locate and space fastenings in uniform vertical and horizontal alignment.
8. Install flashing and trim as metal wall panel work proceeds.
9. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
10. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
11. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
12. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.

B. Fasteners:

1. Steel Wall Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal wall panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in CSI Division 07 Section 079200, "Joint Sealants."

E. Lap-Seam Metal Wall Panels: Fasten metal wall panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal wall panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Provide sealant tape at lapped joints of metal wall panels and between panels and protruding equipment, vents, and accessories.
6. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps; on side laps of nesting-type panels; on side laps of corrugated nesting-type, ribbed, or fluted panels; and elsewhere as needed to make panels weathertight.
7. At panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

F. Zee Clips: Provide Zee clips of size indicated or, if not indicated, as required to act as standoff from subgirts for thickness of insulation indicated. Attach to subgirts with fasteners.

G. Metal Liner Panels: Install panels on girts as indicated on Drawings.

3.4 ACCESSORY INSTALLATION:

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as

indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.5 FIELD QUALITY CONTROL:

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal panel installation, including accessories. Report results in writing.

B. Metal wall panels will be considered defective if they do not pass test and inspections.

3.6 CLEANING AND PROTECTION:

A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION 074213

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Mechanically fastened polyvinyl-chloride (PVC) roofing system.
2. Vapor retarder.
3. Roof insulation.
4. Cover Board.
5. Roof-to-roof expansion joint.
6. Roof-to-wall expansion joint.

B. Related CSI Sections include the following:

1. Division 05 Section 052100, “Steel Decking” for furnishing acoustical deck rib insulation.
2. Division 06 Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
3. Division 07 Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
4. Division 07 Section 077100 “Roof Specialties”.
5. Division 07 Section 077200 "Roof Accessories”.
6. Division 07 Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
7. Division 22 Section 221423 "Storm Drainage Piping Specialties" for roof drains.

1.2 DEFINITIONS:

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS:

A. Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 818 Article 1.20-1.05.24 subsection 2.

1. Meet with Owner, Designer, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.4 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include FM Global RoofNav Assembly Number.
2. Include FM Global Application for Acceptance of Roofing System (Form X2688), Checklist for Roofing System. A copy of this document immediately follows this Section.

C. Roofing System Shop Drawings: Include plans, elevations, sections, details, and attachments to other work, including:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
5. FM Global submittal forms for the roofing system.

D. Roof Warranty Sign Shop Drawings: Materials: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thickness indicated, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 deg F and of the following general types:

1. Opaque Sheet: Provide plaque sign that is manufactured from 1/8” thick laminated engraving stock.

2. Engraved Copy: Engraved copy characters through the first background layer to expose the contrasting color of the inner core of the engraving stock.

    a. Panel Size: 18”x20”, long side horizontal.
    b. Engraving Stock Thickness: 1/8-inch minimum.
    c. Engraved Letter proportion: Letters and Numbers on signs shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10.
    d. Engraved Letter Size: Characters shall be 5/8 inch high.
    e. Background or first layer of engraving stock: Black
    f. Inner core of engraving stock: White
    g. Engraved letter style: Helvetica Medium with all upper case letters.
    h. Mounting Methods and Panel Information Configuration: Mechanical mounting as indicated in PART 3.13 of this Section.

E. Samples for Verification: For the following products:

1. 6 X 6 inch square of sheet roofing, of color specified including T-shaped side and end lap seam.
2. Digital roof warranty sign including all information in Part 3.

F. Qualification Data: For Installer and manufacturer.

G. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in Part 2.3 "Performance Requirements".

1. Submit evidence of compliance with performance requirements.
2. F.M. Roof Nav#

H. Product Test Reports: For components of roofing system, for tests performed by manufacturer and witnessed by a qualified testing agency.

I. Sample Warranties: For each type of warranty.

J. Quality Assurance Submittals:

1. Manufacturer Qualifications: Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Qualification Data: For Installer and manufacturer.
3. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.
4. Research/Evaluation Reports: For components of membrane roofing system.

K. Maintenance Data: For roofing system to include in maintenance manuals to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14

subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE:

A. Qualifications: A qualified manufacturer that is FM Global approved for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.7 FIELD CONDITIONS:

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.8 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Roofing Manufacturer's Warranty: Submit a written warranty, without monetary limitation (no-dollar-limit), signed by roofing system manufacturer agreeing to promptly repair leaks resulting from defects in factory materials or site workmanship. Warranty shall cover the entire roofing system and shall be an all- inclusive "edge-to-edge" warranty, including but not limited to performance of design wind speed included on the Structural Drawings. All roofing work performed under this Section including membrane roofing, sheet flashing, PVC-coated metal flashing, roof insulation, metal flashing, fasteners, and all accessories required by the roofing system manufacturer for the installation, shall be warranted by the roofing manufacturer for the following warranty period: 20 years from the issuance of the Certificate of Compliance.

C. Special Project Warranty: All work included under this Section including membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, shall be warranted by the Contractor for the following warranty period: 2 years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Source Limitations: Obtain components including roof insulation fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

B. Membrane Roofing Manufactures: Subject to compliance with requirements, membrane roofing manufacturers offering products that may be incorporated into the Work are limited to the following:

1. Johns Manville.
2. GAF.
3. Sarnafil Inc.

2.2 PERFORMANCE REQUIREMENTS:

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.

1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:

1. Uplift Pressures: Refer to Architectural Roof Plan.

D. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a built-up roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-105.
2. Hail-Resistance Rating: MH.
3. Approval Category for Wind Zone: HM-SM (hurricane-prone region with small debris impact).
4. Design Loads: Refer to Structural Drawings.
5. FM Global Data Sheet 1-28 Wind Design and 1-29 Roof Deck Securement and Above-Deck Components.

a. PVC Mechanical Fastening Requirements:

1) Due to the building being in a hurricane prone region and the field of roof pressures being above 75 psf, the PVC mechanical fasteners in the perimeters and corners shall have decreased fastener spacings to comply with the following:

a) Perimeters: In seam mechanical fastener row spacing shall be no more than 60% of the FM Approved row spacing for the required wind uplift resistance rating. Point-attached mechanical fastener tributary area between fasteners shall be no more than 60% of the FM Approved spacing.
b) Corners: In seam mechanical fastener row spacing shall be no more than 40% of the FM Approved row spacing for the required wind uplift resistance rating. Point-attached mechanical fastener tributary area between fasteners shall be no more than 40% of the FM Approved spacing.

6. FM Global Data sheet 1-49 Perimeter Flashing.

E. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

F. U-Factor: Provide maximum U-factor of 0.039 for roof assembly as required by IECC.

2.3 PVC ROOFING:

A. PVC Sheet: ASTM D 4434/D 4434M, Type III, fabric reinforced.

1. Thickness: 80 mils.
2. Exposed Face Color: White.

2.4 AUXILIARY ROOFING MATERIALS:

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement and color as PVC sheet.

C. Bonding Adhesive: Manufacturer’s standard. Apply solvent based bonding adhesive when transitioning vertically at a rate required by the manufacturer, allow it to partially dry before installing roof membrane. Don not apply bonding adhesive to splice areas of roofing.

D. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

E. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 VAPOR RETARDER:

A. Polyethylene Film: Provide manufacturer standard vapor barrier located over the Wash Bay.

2.6 ROOF INSULATION:

A. General: Preformed roof insulation boards manufactured by PVC roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.7 INSULATION ACCESSORIES:

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.

B. Fasteners:

1. In seam PVC fastening system: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to metal deck, and acceptable to roofing system manufacturer.
2. Point-attached PVC fastening system: Factory-coated steel fasteners and manufacturer’s standard adhesive coated induction-welded plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to metal deck, and induction-welding PVC membranes to the plates.

2.8 COVER BOARD:

A. Provide manufacturers standard recommended cover board to be installed over the roof insulation. Thickness shall be 1/2 inch minimum. Product must be warrantable with the whole roof membrane system.

2.9 WALKWAYS:

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway rolls, and acceptable to roofing system manufacturer.

2.10 ROOF TO ROOF EXPANSION JOINT:

A. Roof to roof, elastomeric bellow with fiber glass batt insulation filled with integral vapor barrier insulation support and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in CSI Division 05 Section 053100, "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 ROOFING INSTALLATION, GENERAL:

A. Install roofing system according to roofing system manufacturer's written instructions.

1. All rows of roof cover fasteners shall be installed perpendicular to the steel roof deck flutes.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 VAPOR-RETARDER INSTALLATION:

A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches and 6 inches, respectively. Continuously seal side and end laps with tape.

3.5 INSULATION INSTALLATION:

A. Install tapered insulation under area of roofing to conform to slopes indicated.

B. Install insulation under area of roofing to achieve required thickness. Minimum thickness of insulation at roof edge shall be 6 inches. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

C. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

D. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

E. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

F. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.

1. Fasten cover boards according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof. For cover boards located within the perimeter and corners, the increased fastening amount shall be applied to the entire cover board.

3.6 MECHANICALLY FASTENED IN SEAM ROOFING INSTALLATION:

A. Mechanically fasten roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

1. Install sheet according to ASTM D 5082.

2. For in-splice attachment, install roofing with long dimension perpendicular to steel roof deck flutes.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. In-Seam Attachment: Secure one edge of PVC sheet using fastening plates or metal battens centered within seam, and mechanically fasten PVC sheet to roof deck.

E. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

F. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.7 MECHANICALLY FASTENED POINT-ATTACHED INSTALLATION:

A. Mechanically fasten roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

1. Install sheet according to ASTM D 5082.
2. For in-splice attachment, install roofing with long dimension perpendicular to steel roof deck flutes.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Point-attached Attachment: Mechanically fasten roofing by induction welding the membrane to the adhesive coated insulation fasteners by using calibrated induction welding tools and magnetic cooling clamps according to manufacturer’s instructions. Keep clamps clean with a clean cotton rag. PVC shall be bonded completely to the fastener plates. Repair bonds that do not comply with requirements.

E. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

F. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.8 ADHERED ROOFING INSTALLATION:

A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

1. Install sheet according to ASTM D 5036.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Self-Adhered PVC Membrane: Apply Self-Adhered PVC Membrane in the locations indicated at the rate required by manufacturer.

E. Bonding Adhesive: If Bonding Adhesive is required, apply solvent-based bonding adhesive when transitioning vertically at a rate required by the manufacturer, allow it to partially dry before installing roof membrane. Do not apply bonding adhesive to splice areas of roofing.

F. Mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

H. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.

1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.

I. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.

a. Remove and repair any unsatisfactory sections before proceeding with Work.

3. Repair tears, voids, and lapped seams in roofing membrane that do not meet requirements.

J. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

K. Install roofing membrane and auxiliary materials to tie in to existing roofing.

L. Proceed with installation only after unsatisfactory conditions have been corrected.

3.9 WALKWAY INSTALLATION:

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

1. Walkway pad shall not be installed over field seams.

3.10 ROOF TO ROOF EXPANSION JOINT:

A. Install roof to roof expansion joint in location indicated. Install per roofing system manufacturer's written instructions and detail.

3.11 FIELD QUALITY CONTROL:

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

1. Notify Engineer seven (7) calendar days in advance of date and time of inspection.

B. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood each area for 24 hours.
2. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.12 PROTECTING AND CLEANING:

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to the Engineer.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of the issuance of the Certificate of Compliance and according to requirements.

C. Clean overspray and spillage using cleaning agents and procedures recommended by manufacturer of affected construction.

D. Clean roof of debris, dirt and stains after installation is complete. Clean roof using cleaning agents and procedures recommended by manufacturer of affected construction.

3.13 INSTALLATION OF ROOF WARRANTY SIGN:

A. The Roof Warranty Sign shall be permanently anchored with stainless steel fasteners at all four corners of the panel to the facility in an extruded aluminum with clear anodized finish frame, adjacent to the roof hatch ladder, unless otherwise directed by the Engineer. Panel sign shall include the following information:

NEW ROOF INSTALLATION WARRANTY

CTDOT (Project #): 0115-0121
PUTNAM MAINTENANCE FACILITY
PUTNAM REPAIR FACILITY
COLD STORAGE

WARRANTY START DATE: (X/X/XX)
(Date of the issuance of the Certificate of Compliance)

ROOF TYPE: (Type of roof installed),

(i.e. Johns-Manville International, Inc. PVC Membrane)

WARRANTY: (Manufacturer's name and type of warranty), 20 yr NDL

WARRANTY NUMBER: (Actual Warranty number)

INSTALLER: (Contractor's name, town located, and telephone number.)

AFTER 2 YEARS CONTACT MANUFACTURER: (Manufacturer's name and telephone number of warranty service)

END OF SECTION 075419

SECTION 075420 - CHECKLIST FOR ROOFING SYSTEM

CONTACT INFORMATION: **INDEX NUMBER:**

ROOFING CONTRACTOR (NAME & ADDRESS)	TELEPHONE NO.:	**FAX:**
	E-MAIL ADDRESS:	**CONTACT:**
CLIENT (NAME & ADDRESS)	TELEPHONE NO.:	**FAX:**
	E-MAIL ADDRESS:	**CONTACT:**

OVERVIEW OF WORK: *(Submit 1 form per roof area)*

Building Name & Number:		
Building Dimensions: Length: *ft/m;*	Width: *ft/m.;*	Height *ft/m.*
Roof Slope:		
Parapet Height ,max *(in./m)*:	Parapet Height ,min *(in /m):*	
Type of Work: ☐ New Construction ☐ Recover (New roof over existing Roofing System) ☐ Reroof (New cover/remove existing roofing system to deck) ☐ Other		
FM Approved RoofNav Assembly Numbers:		

ROOF SURFACING:

☐ None	
☐ Coating	*(Trade Name/Application Rate)*
☐ Granules	*(Application Rate)*
☐ Gravel/Slag	*(Application Rate)*
☐ Ballast: ☐ Stone Size ☐ Pavers *(Beveled or square edge)*; ☐ Other: Ballast Weight (psf): Field: Perimeter: Corners:	

ROOF COVER/MEMBRANE:
(Please provide ALL applicable details including trade name, type, number of plies, thickness, reinforced, adhesive)

☐ Panel: ☐ Through Fastened Metal ☐ Standing Seam metal ☐ Fiber Reinforced Plastic (FRP) ☐ Other:			
☐ Single Ply:	☐ Adhered	☐ Fastened	☐Ballasted
☐ Built Up Roofing (BUR)			
☐ Modified Bitumen	☐ Lap Width in/mm	☐ Lap Adhesion Type	
☐ Spray Applied			
☐ Other:			

BASE SHEET:
(Please include Trade Name, Type, and Width)

☐ None		
Trade Name:		Width: ☐ 36 In. ☐ 1 meter (39 In.)
☐ Fastened		☐ Adhered
☐ Secured per RoofNav	**OR**	☐ Per FM Global Loss Prevention Data Sheet 1-29
Comments:		
☐ Lap Width in/mm		☐ Lap Adhesion Type
☐ Air Retarder		☐ Vapor Retarder

INSULATION

Layer	**Trade Name**	**Thickness (In.)**	**Fastened**	**Adhered**	**Tapered**
1. Top			☐	☐	☐
2. Next			☐	☐	☐
3. Next			☐	☐	☐
4. Next			☐	☐	☐

☐ Glass Fiber/Mineral Wool/Batt	☐ Facer Type/Vapor Barrier
☐ Thermal Barrier	

☐ Other:	
☐ None	

DECK:
(Please include manufacturer, type, yield strength, thickness/gage, etc.)

☐ Steel:	
☐ LWIC (Form Deck):	☐ Cementitious Wood Fiber:
☐ Concrete: ☐ Pre-cast panels or ☐ Cast in Place	
☐ Wood	
☐ Fiber Reinforced Cement	☐ Fiber Reinforced Plastic
☐ Gypsum: ☐ Plank	☐ Poured
☐ Other:	
Comments:	

ROOF STRUCTURE (Include Size, Gage, Etc.):

☐ Purlins ☐ "C" OR ☐ "Z"		
☐ Joists ☐ Wood OR ☐ Steel		
☐ Beams ☐ Wood OR ☐ Steel		
☐ Other:		
Spacing: Field:	Perimeter:	Corners:
Comments:		

FASTENERS USED IN ROOF ASSEMBLY:

Roof Cover Fasteners: Trade Name:		Length:	Diameter:
Stress Plate/Batten:			
Spacing: Field: X	Perimeter: X	Corners: X	
Insulation Fasteners: Trade Name:	Type:		
Size:	Stress Plate:		
Spacing: Field:	Perimeter:	Corners:	
Deck Or Roof Panels Fasteners: Trade Name:	Type:		
Length:	Size Washer:		
If Weld: Size:	Weld:	Washer:	
Deck Side Lap Fasteners: Field: X	Perimeter: X	Corners: X	
Spacing: Field: X	Perimeter: X	Corners: X	
Base Sheet Fasteners Trade Name:	Type:		
Head Diameter:	Length:		
Spacing: (Attached Sketches as necessary) Spacing Along Laps: Field:	Perimeter:	Corners:	
No. Intermediate Rows: Field:	Perimeter:	Corners:	
Spacing Along Intermediate Rows: Field:	Perimeter:	Corners:	

PERIMETER FLASHING:
(Attach a detailed sketch of metal fascia, gravel stop, nailer, coping, etc.)

☐ FM Approved Flashing	Manufacturer/Trade Name:
☐ Other:	Flashing Max Wind Rating:
Nailer Size / Securement Per FM Global Data Sheet 1-49? ☐ Yes ☐ No	
Comments:	

DRAINAGE:

For new construction: Has roof drainage been designed by a Qualified Engineer per FM Global Loss Prevention Data Sheet 1-54 and the local building code? ☐ Yes ☐ No (Attach details)
For re-roofing and recovering: will the roof drainage be changed from the original design (for example: drain inserts, drains covered or removed, new expansion joints, blocked or reduced scupper size? ☐ Yes ☐ No If yes, were the changes reviewed by a Qualified Engineer? ☐ Yes ☐ No (Attach details)
Is secondary (emergency) roof drainage provided per FM Global Data Sheet 1-54? ☐ Yes ☐ No (Attach details)

FM Global OFFICE REVIEW
(Please leave blank for FM Global Office Review)

WIND:

Design Wind Speed: *(mph)*	Ground Terrain: ☐ B ☐ C ☐ D
Uplift Pressure in field: *(psf)*	Uplift Rating Required:
Adequate Uplift Rating Provided:	Adequate? ☐ Yes ☐ No

FIRE:

Internal Assembly Rating:	☐ Class 1	☐ Class 2	☐ Non-Combustible	
External Fire Rating:	☐ Class A	☐ Class B	☐ Class C	☐ None
Concealed Spaces?	☐ Yes	☐ No	Sprinklers below Roof?	☐ Yes ☐ No
Adequate?	☐ Yes	☐ No		

HAIL:

Hail Zone ☐ VSH ☐ SH ☐ MH	Hail Rating Provided ☐VSH ☐ SH ☐ MH
	FM 4473 Specification Class (if provided): ☐2 ☐3 ☐4
Adequate? ☐ Yes ☐ No	

COLLAPSE:

If standing seam, has collapse been reviewed? ☐ Yes ☐ No

COMMENTS:

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Manufactured surface-mounted flashing.
2. Formed wall sheet metal fabrications.
3. Formed equipment support flashing.

B. Related CSI Sections:

1. Division 04 Section 042000, "Unit Masonry" for installing through-wall flashing, and other sheet metal flashing and trim.
2. Division 06 Section 061000, "Rough Carpentry" for wood nailers, curbs, and blocking.
3. Division 07 Section 075419, "Polyvinyl-Chloride (PVC) Roofing" for installation of sheet metal flashing and trim integral with roofing.
4. Division 07 Section 077100, "Roof Specialties" for manufactured roof specialties not part of sheet metal flashing and trim.
5. Division 07 Section 077200, "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
6. Division 07 Section 079200, "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

1.2 COORDINATION:

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

C. Fastener Schedule: Include the following information:

1. Fastener application, location, and designation.
2. Fastener manufacturer and product name.

D. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Include identification of material, thickness, weight, and finish for each item and location in Project.
3. Include details for forming, including profiles, shapes, seams, and dimensions.
4. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
5. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.

E. Samples for Initial Selection:

1. For each type of sheet metal flashing and accessory indicated with factory-applied finishes.
2. Physical color palette of manufacturer's full range of colors for each type of flashing and accessories indicated.

F. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.4 QUALITY ASSURANCE:

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are FM approved, shop shall be listed as able to fabricate required details as tested and approved.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

2.2 SHEET METALS:

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

1. As-Milled Finish: Standard two-side bright finish.
2. Surface: Smooth, flat.
3. Color: As selected by Designer from Manufacturer’s full range of colors.

C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.

1. Finish: No.4 (polished directional satin).

2. Surface: Smooth, flat.
3. Color: As selected by Designer from Manufacturer's full range of colors.

2.3 UNDERLAYMENT MATERIALS:

A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

2.4 MISCELLANEOUS MATERIALS:

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight. Refer to CSI Specification 079200 "Joint Sealants".

E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement. Refer to CSI Specification 079200 "Joint Sealants".

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM:

A. Surface-Mounted Flashing: Manufactured surface-mounted flashing for masonry, with termination bar and drip edge.

1. Stainless Steel Drip Edge: 3" 26 ga.
2. Termination Bar: 3" manufacturer standard Stainless Steel.
3. Flashing: 40 mil, 18" wide, pressure sensitive, self-adhering, self-sealing composite flexible flashing designed to be applied over concrete and masonry surfaces with inside and outside corners.

a. Available products:

1) W.R. Grace & Co.; Perm-A-Barrier Wall Flashing.
2) Hohmann & Barnard, Inc.; Flex-Flash Surface-Mount Flashing.
3) Wire-Bond; Rhino-Bond Flashing.

b. Color: As selected by Designer from Manufacturer's full range of colors.

2.6 FABRICATION, GENERAL:

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim to fit substrate without excessive oil canning, buckling, and tool marks and true to line, levels and slopes and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

D. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

E. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

F. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

G. Do not use graphite pencils to mark metal surfaces.

2.7 WALL SHEET METAL FABRICATIONS:

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch long, but not exceeding 12-foot long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings and form with 2-inch high, end dams. Fabricate from the following materials:

1. Aluminum: 0.040 inch thick.

B. Wall Expansion-Joint Cover: Fabricate from the following materials:

1. Aluminum: 0.040 inch thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS:

A. Equipment Support Flashing: Fabricate from the following materials:

1. Aluminum: 0.040 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION:

A. General: Install underlayment as indicated on the plans.

B. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.3 INSTALLATION, GENERAL:

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminun and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting

proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in CSI Division 07 Section 079200, "Joint Sealants."

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel and aluminum sheet.
2. Pre-tinning is not required for zinc-tin alloy-coated stainless steel and zinc-tin alloy-coated copper.
3. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
4. Copper Soldering: Tin edges of uncoated copper sheets using solder for copper.
5. Copper-Clad Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for copper-clad stainless steel.

G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 ROOF FLASHING INSTALLATION:

A. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant.

3.5 WALL FLASHING INSTALLATION:

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in CSI Division 04 Section 042000, "Unit Masonry."

3.6 MISCELLANEOUS FLASHING INSTALLATION:

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.7 CLEANING AND PROTECTION:

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Copings.
2. Roof-edge flashings.

B. Related CSI Sections:

1. Division 06 Section 061000, "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Division 07 Section 076200, "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
3. Division 07 Section 077200, "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
4. Division 07 Section 079200, "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

1.2 PERFORMANCE REQUIREMENTS:

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. FM Approvals' Listing: Manufacture and install roof-edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-60. Identify materials with FM Approvals' markings.

C. SPRI Wind Design Standard: Manufacture and install roof-edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: 26 psf-outward force; 42 psf-uplift force.

D. Water Infiltration: Provide manufactured roof specialties that do not allow water infiltration into building interior.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of

thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Fastener Schedule: Include the following information:

1. Fastener application, location, and designation.
2. Fastener manufacturer and product name.

D. Shop Drawings: For roof specialties. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work. Include the following:

1. Details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
2. Pattern of seams and layout of fasteners, cleats, clips, and other attachments.

E. Samples for Initial Selection:

1. For each type of roof specialties indicated with factory-applied finishes.
2. Physical color palette of manufacturer's full range of colors for each type of roof specialties indicated.

F. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.4 QUALITY ASSURANCE:

A. Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 818 Article 1.20-1.05.24 subsection 2. Review the following:

1. Meet with Owner, Engineer, Designer, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects roof specialties including installers of roofing materials and accessories.

2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

PART 2 - PRODUCTS

2.1 EXPOSED METALS:

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

1. Surface: Smooth, flat finish.
2. Three-Coat Fluoropolymer: AAMA 620. System consisting of primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent PVDF resin by weight.
3. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
4. Color: As selected by Designer from Manufacturer's full range of colors.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

1. Exposed High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

   a. Three-Coat Fluoropolymer: AAMA 2605. System consisting of primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent PVDF resin by weight.

2. Color: As selected by Designer from Manufacturer's full range of colors.

2.2 CONCEALED METALS:

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

D. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.

2.3 UNDERLAYMENT MATERIALS:

A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

2.4 MISCELLANEOUS MATERIALS:

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.

C. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application. Refer to CSI Specification 079200 “Joint Sealants”.

D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement. Refer to CSI Specification 079200 “Joint Sealants”.

2.5 GENERAL FINISH REQUIREMENTS:

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. 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.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION:

A. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.3 INSTALLATION, GENERAL:

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of self-adhering, high-temperature sheet underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise shown on plans.
2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal joints with elastomeric sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches except reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.4 COPING INSTALLATION:

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings to meet performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

3.5 ROOF-EDGE FLASHING INSTALLATION:

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant. Fit counterflashings tightly to base flashings.

3.6 CLEANING AND PROTECTION:

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077100

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Roof hatches and safety railing.
2. Fall Protection Guardrail.

B. Related CSI Sections include the following:

1. Division 05 Section 055000, "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
2. Division 06 Section 061000, "Rough Carpentry" for roof sheathing, wood cants, and wood nailers.
3. Division 07 Section 076200, "Sheet Metal Flashing and Trim" for shop- and field-fabricated metal flashing and counterflashing, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
4. Division 07 Section 077100, "Roof Specialties" for fascia and copings.
5. Division 07 Section 079200, “Joint Sealants” for field-applied sealants between roof accessories and adjacent materials.
6. Division 23 Section 233423, "HVAC Power Ventilators" for power roof-mounted ventilators.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Fastener Schedule: Include the following information:

1. Fastener application, location, and designation.
2. Fastener manufacturer and product name.

D. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.

E. Samples for Initial Selection:

1. Physical color palette of manufacturer's full range of colors.

F. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.3 QUALITY ASSURANCE:

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.5 PROJECT CONDITIONS:

A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION:

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

1. With Designer's approval, adjust location of roof accessories that would interrupt roof drainage routes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers listed in other portions of Part 2.

2.2 METAL MATERIALS:

A. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coated.

B. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by hot-dip process and prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coated.
2. Exposed Finishes: High-Performance Organic Finish (2-Coat Fluoropolymer): Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements in AAMA 2605, except as modified below:

1) Humidity Resistance: 2000 hours.
2) Salt-Spray Resistance: 2000 hours.

C. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by manufacturer for type of use and finish.

1. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Conversion coating; Organic Coating: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturer's written instructions.

a. Color and Gloss: As selected by Designer from manufacturer's full range of colors and gloss.

D. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use, mill finished.

E. Stainless-Steel Shapes or Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304 or Type 316, No. 2D finish.

F. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized to comply with ASTM A 123/A 123M, unless otherwise indicated.

G. Steel Tube: ASTM A 500, round tube, baked-enamel finished.

H. Galvanized Steel Tube: ASTM A 500, round tube, hot-dip galvanized to comply with ASTM A 123/A 123M.

I. Galvanized Steel Pipe: ASTM A 53/A 53M.

2.3 MISCELLANEOUS MATERIALS:

A. Acrylic Glazing: ASTM D 4802, thermoformable, monolithic sheet, category as standard with manufacturer, Type UVA (formulated with UV absorber), Finish 1 (smooth or polished).

B. Polyisocyanurate Board Insulation: ASTM C 1289, 1 inch thick.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches thick.

D. Polyethylene Sheet: 6-mil thick, polyethylene sheet complying with ASTM D 4397.

E. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

1. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft.

F. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.

G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

H. Elastomeric Sealant: ASTM C 920, silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight. Refer to CSI Specification 079200 “Joint Sealants”.

I. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement. Refer to CSI Specification 079200 “Joint Sealants”.

2.4 ROOF HATCHES:

A. Roof Hatches: Fabricate roof hatches with insulated double-wall lids and insulated double-wall curb frame with integral deck mounting flange and lid frame counterflashing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weathertight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.

1. Available Manufacturers:

a. Babcock-Davis; a Cierra Products Inc. Company.
b. Bilco Company (The).

2. Loads: Fabricate roof hatches to withstand 40-lbf/sq. ft. internal and 20-lbf/sq. ft. external loads.
3. Type and Size: Single-leaf lid, 30 by 36 inches.
4. Curb and Lid Material: Stainless-steel sheet, 0.078 inch thick.

   a. Finish: Mill.

5. Insulation: Cellulosic-fiber board.
6. Interior Lid Liner: Manufacturer's standard metal liner of same material and finish as outer metal lid.
7. Exterior Curb Liner: Manufacturer's standard metal liner of same material and finish as metal curb.
8. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
9. Fabricate units to minimum height of 12 inches, unless otherwise indicated.
10. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate hatch curbs with height tapered to match slope to level tops of units.
11. Hardware: Galvanized steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

2.5 SAFETY RAILING:

A. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

1. Height: 42 inches above finished roof.
2. Posts and Rails: Aluminum with powder coat finish, 1-1/4 inches.
3. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
4. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer’s standard hinges and self-latching mechanism.Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
5. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
6. Fabricate joints exposed to weather to be watertight.
7. Fasteners: Manufacturer's standard, finished to match railing system.

2.6 FALL PROTECTION:

A. Fall Protection: A guardrail system consisting of a top and mid rail in accordance with OSHA Standards 29 CFR 1910.20 and CFR 1926.502:

1. Structural Load: 200lb, minimum, in any direction to all components in accordance with OSHA Standards 29 CFR 1910.20 and CFR 1926.502.
2. Height: 42 inches (1067 mm). minimum.
3. Railing: 1.66”O.D. galvanized pipe.
4. Mounting Bases: Class 30 gray iron material cast with four receiver post. Base weight 108 lb. Rubber pads on the bottom.
5. Finishes: Factory standard hot-dip galvanized.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
2. Verify dimensions of roof openings for roof accessories.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Install roof accessories to fit substrates and to result in watertight performance.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.

D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

E. Roof Hatch Installation:

1. Check roof hatch for proper operation. Adjust operating mechanism as required. Clean and lubricate joints and hardware.

F. Safety Railing Installation:

1. Install components per manufacturer’s installation.

G. Fall Protection Installation:

1. Install components per manufacturer’s installation.

H. Seal joints with elastomeric sealant as required by manufacturer of roof accessories.

3.3 TOUCH UP:

A. Touch up factory-primed surfaces with compatible primer ready for field painting in accordance with CSI Division 09 painting Sections.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.4 CLEANING:

A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

B. Related CSI Sections include the following:

1. Division 07 Section 078446, "Fire-Resistive Joint Systems."
2. Division 22 and 23 Sections specifying duct and piping penetrations.
3. Division 26, 27, and 28 Sections specifying cable and conduit penetrations.

1.2 PERFORMANCE REQUIREMENTS:

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire walls, fire partitions.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

a. Penetrations located outside wall cavities.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

D. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

E. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
4. Qualification Data: For Installer.
5. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.

6. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.4 QUALITY ASSURANCE:

A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1.2, "Performance Requirements":

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per testing standard referenced in Part 1.2 “Performance Requirements.” Provide rated systems complying with the following requirements:

a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:

1) UL in its "Fire Resistance Directory."

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver through-penetration firestop system 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, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 PROJECT CONDITIONS:

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.7 COORDINATION:

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Engineer's inspecting agency at least seven calendar days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include, but are not limited to, those systems indicated that are produced by one of the following manufacturers:

1. A/D Fire Protection Systems Inc.
2. Grace, W. R. & Co. - Conn.
3. Hilti, Inc.
4. Johns Manville.
5. Nelson Firestop Products.
6. NUCO Inc.
7. RectorSeal Corporation (The).

8. Specified Technologies Inc.
9. 3M; Fire Protection Products Division.
10. Tremco; Sealant/Weatherproofing Division.
11. USG Corporation.

2.2 FIRESTOPPING, GENERAL:

A. Compatibility: Provide through-penetration 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.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by 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 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.

2.3 FILL MATERIALS:

A. General: Provide through-penetration firestop systems containing the types of fill materials required. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

I. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING:

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION:

A. General: Install through-penetration firestop systems to comply with Part 1.2 "Performance Requirements," and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
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.

3.4 FIELD QUALITY CONTROL:

A. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.5 CLEANING AND PROTECTING:

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of the issuance of the Certificate of Compliance. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes fire-resistive joint systems for the following:

1. Floor-to-wall joints.
2. Head-of-wall joints.
3. Wall-to-wall joints.

B. Related CSI Sections include the following:

1. Division 07 Section 078413, "Penetration Firestopping" for systems installed in openings in walls and floors with and without penetrating items.
2. Division 07 Section 079200, "Joint Sealants" for non-fire-resistive joint sealants.

1.2 PERFORMANCE REQUIREMENTS:

A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.

B. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, and with movement capabilities and L-ratings indicated as determined by UL 2079.

1. Load-bearing capabilities as determined by evaluation during the time of test.

C. Perimeter Fire-Resistive Joint Systems: For joints between edges of fire-resistance-rated floor assemblies and exterior curtain walls, provide systems of type and with ratings indicated below and those indicated in the Fire-Resistive Joint System Schedule at the end of Part 3, as determined by NFPA 285 and UL 2079.

1. UL-Listed, Perimeter Fire-Containment Systems: Integrity ratings equaling or exceeding fire-resistance ratings of floor or floor/ceiling assembly forming one side of joint.

D. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.

D. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

E. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.

F. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE:

A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

C. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

D. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1.2, "Performance Requirements":

1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing

testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.

2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1.2 "Performance Requirements" and comply with the following:

    a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
    b. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 PROJECT CONDITIONS:

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.7 COORDINATION:

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Notify Engineer's inspecting agency at least 7 calendar days in advance of fire-resistive joint system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Engineer and authorities having jurisdiction have examined each installation.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS:

A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience. Fire-resistive joint systems shall be white and paintable with paint systems for adjacent construction.

B. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1.2, "Performance Requirements". Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning

methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3 INSTALLATION:

A. General: Install fire-resistive joint systems to comply with Part 1.2 "Performance Requirements" and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL:

A. Inspecting Agency: Engage a qualified independent inspecting agency that is acceptable to the Engineer to inspect fire-resistive joint systems and prepare inspection reports.

B. Testing Services: Inspecting of completed installations of fire-resistive joint systems shall take place in successive stages as installation of fire-resistive joint systems proceeds. Do not proceed with installation of joint systems for the next area until inspecting agency determines completed work shows compliance with requirements.

1. Inspecting agency shall state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.

C. Remove and replace fire-resistive joint systems where inspections indicate that they do not comply with specified requirements.

D. Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and fire-resistive joint systems comply with requirements.

3.5 CLEANING AND PROTECTING:

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of the issuance of the Certificate of Compliance. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 078446

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Preformed joint sealants.
3. Acoustical joint sealants.
4. Butyl joint sealants.

B. Related CSI Sections:

1. Division 04 Section 042000, "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Division 07 Section 078446, "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
3. Division 08 Section 088000, "Glazing" for plastic sealants.
4. Division 09 Section 092900, "Gypsum Board" for sealing perimeter joints.
5. Division 09 Section 093000, "Tiling" for sealing tile joints.

1.2 PERFORMANCE REQUIREMENTS:

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each joint-sealant product indicated.

C. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2.

D. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

E. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

F. Qualification Data: For qualified Installer and testing agency.

G. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

H. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

1.5 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Colors of Exposed Joint Sealants: As selected by Designer from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 790.
b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
c. Tremco Incorporated; Spectrem 1.

B. Multicomponent, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Tremco Incorporated; Spectrem 4TS.

C. Multicomponent, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type M, Grade P, Class 100/50, for Use T.

1. Avaiable Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Dow Corning Corporation; FC Parking Structure Sealant.

D. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Pecora Corporation; 898.

2.3 PREFORMED JOINT SEALANTS

A. Preformed Silicone Joint Sealants: Manufacturer's standard sealant consisting of precured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Dow Corning Corporation; 123 Silicone Seal.
    b. GE Advanced Materials - Silicones; UltraSpan US1100.
    c. Pecora Corporation; Sil-Span.

B. Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. EMSEAL Joint Systems, Ltd.; Emseal 25V.
    b. Schul International, Inc.; Sealtite.
    c. Willseal USA, LLC; Willseal 150.

2.4 ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pecora Corporation; AC-20 FTR.
b. USG Corporation; SHEETROCK Acoustical Sealant.

2.5 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: Manufacturer’s standard single-component, solvent-release butyl rubber sealant plasticized from polyisobutylene and complying with ASTM C1311.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pecora Corporation; BC-158.

2.6 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

    1. Do not leave gaps between ends of sealant backings.
    2. Do not stretch, twist, puncture, or tear sealant backings.
    3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

    1. Place sealants so they directly contact and fully wet joint substrates.
    2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

G. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:

1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

I. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of the issuance of the Certificate of Compliance. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 079500 – EXPANSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Architectural joint systems for building interiors.
2. Architectural joint systems for building exteriors.

B. Related CSI Sections include the following:

1. Division 04 Section 042000, "Unit Masonry" for masonry wall joint systems.
2. Division 07 Section 076200, "Sheet Metal Flashing and Trim" for sheet metal wall joint systems.

1.2 DEFINITIONS:

A. Maximum Joint Width: Widest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

B. Minimum Joint Width: Narrowest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

C. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage (plus or minus) of nominal value of joint width.

D. Nominal Joint Width: The width of the linear opening specified in practice and in which the joint system is installed.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

1. Architectural Joint System Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:

a. Manufacturer and model number for each joint system.
b. Joint system location cross-referenced to plans.
c. Nominal joint width.
d. Movement capability.
e. Classification as thermal or seismic.

f. Materials, colors, and finishes.
g. Product options.

h. Fire-resistance ratings.

B. Samples for Initial Selection: For each type of joint system indicated.

1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric seal material.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for current products.

1.4 QUALITY ASSURANCE:

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain architectural joint systems through one source from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of architectural joint systems and are based on the specific systems indicated.

1. Do not modify intended aesthetic effects, as judged solely by Designer, except with Designer's approval. If modifications are proposed, submit comprehensive explanatory data to Designer for review.

D. Fire-Test-Response Characteristics: Where indicated, provide architectural joint system and fire-barrier assemblies identical to those of assemblies tested for fire resistance per UL 2079 or ASTM E 1966 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Hose Stream Test: Wall-to-wall and wall-to-ceiling assemblies shall be subjected to hose stream testing.

1.5 COORDINATION:

A. Coordinate installation of exterior wall joint systems with roof expansion assemblies to ensure that wall transitions are watertight. Roof expansion assemblies are specified in CSI Division 07.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.

1. High-Performance Organic Finish (Two-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2604 and with coating and resin manufacturers' written instructions.

B. Elastomeric Seals: Preformed elastomeric membranes or extrusions to be installed in metal frames.

C. Compression Seals: ASTM E 1612; preformed rectangular elastomeric extrusions having internal baffle system and designed to function under compression.

D. Strip Seals: ASTM E 1783; preformed elastomeric membrane or tubular extrusions having an internal baffle system and secured in or over a joint by a metal locking rail.

E. Cellular Foam Seals: Extruded, compressible foam designed to function under compression.

F. Elastomeric Concrete: Modified epoxy or polyurethane extended into a prepackaged aggregate blend, specifically designed for bonding to concrete substrates.

G. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required rating period.

H. Moisture Barrier: Flexible elastomeric material, PVC, minimum 30 mils thick or Santoprene.

I. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.2 ARCHITECTURAL JOINT SYSTEMS, GENERAL:

A. General: Provide architectural joint systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.

1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where joint changes direction or abuts other materials.
2. Include factory-fabricated closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.

B. Design architectural joint systems for the following size and movement characteristics:

1. Nominal Joint Width: As indicated on plans.
2. Movement Capability: Plus or minus 25 percent.
3. Type of Movement: Thermal.

2.3 ARCHITECTURAL JOINT SYSTEMS FOR BUILDING INTERIORS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Balco, Inc.
2. MM Systems Corporation.
3. Nystrom, Inc.
4. Watson Bowman Acme Corp.

B. Wall-to-Wall Joint Systems:

1. Type: Flat seal.

a. Seal Material: Santoprene.

1) Color: As selected by Designer from manufacturer's full range.

2. Fire-Resistance Rating: Provide joint system and fire-barrier assembly with a rating not less than that of adjacent construction.
3. Moisture Barrier: Manufacturer's standard.

2.4 ARCHITECTURAL JOINT SYSTEMS FOR BUILDING EXTERIORS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. EMSEAL Joint Systems, Ltd.
2. MM Systems Corporation.
3. Watson Bowman Acme Corp.

B. Architectural Joint Systems for Exterior Walls:

1. Type: Flat seal.

a. Seal Material: Silicone.

1) Color: As selected by Designer from manufacturer's full range.

b. Secondary Seal: Manufacturer's standard extruded-elastomeric seal designed to prevent water and moisture infiltration.
c. Pantograph Mechanism: Manufacturer's standard nylon pantographic wind-load support mechanism with stainless-steel fasteners.

2. Fire-Resistance Rating: Provide joint system and fire-barrier assembly with a rating not less than that of adjacent construction.

2.5 FINISHES:

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine surfaces and blockouts where architectural joint systems will be installed for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Prepare substrates according to architectural joint system manufacturer's written instructions.

B. Repair concrete slabs and blockouts using manufacturer's recommended repair grout of compressive strength adequate for anticipated structural loadings.

C. Coordinate and furnish anchorages, setting drawings, and instructions for installing joint systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

D. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

3.3 INSTALLATION:

A. Comply with manufacturer's written instructions for storing, handling, and installing architectural joint assemblies and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install joint systems.

1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Engineer where discrepancies occur that will affect proper joint installation and performance.
3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
4. Locate in continuous contact with adjacent surfaces.
5. Standard-Duty Systems: Shim to level where required. Support underside of frames continuously to prevent vertical deflection when in service.
6. Heavy-Duty Systems: Repair or grout blockout as required for continuous frame support and to bring frame to proper level. Shimming is not allowed.
7. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

D. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both frame interfaces or sides of slabs before installing compression seals.

E. Foam Seals: Install with adhesive recommended by manufacturer.

F. Epoxy-Bonded Seals: Pressurize seal for time period and to pressure recommended by manufacturer. Do not overpressurize.

G. Terminate exposed ends of joint assemblies with field- or factory-fabricated termination devices.

H. Fire-Resistance-Rated Assemblies: Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

I. Water Barrier: Provide water barrier at exterior joints and where called for on Drawings. Provide drainage fittings at a maximum of 50 feet or where indicated.

3.4 PROTECTION:

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over joints. Reinstall cover plates or seals prior to the issuance of the Certificate of Compliance.

END OF SECTION 079500

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Standard hollow metal doors and frames.

B. Related CSI Sections:

1. Division 04 Section 042000, "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
2. Division 08 Section 087100, "Door Hardware" for door hardware for hollow metal doors.
3. Division 08 Section 088000, “Glazing” for door glazing for hollow metal doors.
4. Division 09 Sections 099113, "Exterior Painting" and 099123, "Interior Painting" for field painting hollow metal doors and frames.

1.2 DEFINITIONS:

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.

7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

D. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Plans. Coordinate with door hardware schedule.

E. Quality Assurance Submittals:

1. Manufacturer Qualifications: Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.4 QUALITY ASSURANCE:

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing according to NFPA 252, UL 10C.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project Site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.6 PROJECT CONDITIONS:

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION:

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting plans, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ceco Door Products; an Assa Abloy Group Company.
2. Steelcraft; an Ingersoll-Rand Company.
3. Windsor Republic Doors.

2.2 MATERIALS:

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density;

with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

H. Glazing: Comply with requirements in CSI Division 08 Section 088000, "Glazing."

2.3 STANDARD HOLLOW METAL DOORS:

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

1. Design: As indicated on plans.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.

a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

1) Locations: Exterior doors and interior doors where indicated.

3. Vertical Edges for Single-Acting Doors: Beveled edge.

a. Beveled Edge: 1/8 inch in 2 inches.

4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.
5. Top and Bottom Edges: Closed with flush or inverted 0.042-inchthick, end closures or channels of same material as face sheets.
6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES:

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as full profile welded unless otherwise indicated.
3. Frames for Level 1 Steel Doors: 0.042-inch thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as full profile welded unless otherwise indicated.
3. Fabricate knocked-down, drywall slip-on frames for in-place gypsum board partitions.
4. Frames for Level 1 Steel Doors: 0.042-inch thick steel sheet.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS:

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 HOLLOW METAL PANELS:

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 STOPS AND MOLDINGS:

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

2.8 ACCESSORIES:

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.9 FABRICATION:

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project Site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
6. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb from 60 to 90 inches high.

E. Door Silencers: Drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

F. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

G. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in CSI Division 08 Section 087100, "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with CSI Division 26 Sections.

H. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.

2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.10 STEEL FINISHES:

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

3.2 PREPARATION:

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION:

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with plans and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-protection-rated openings, install frames according to NFPA 80.
b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install door silencers in frames before grouting.
d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
4. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.4 ADJUSTING AND CLEANING:

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 083313 - COILING COUNTER FIRE DOORS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Fire-rated counter doors.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type and size of coiling counter door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

3. Include description of automatic closing device and testing and resetting instructions.

C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.

4. Show locations of all controls, detectors, locking devices, and other accessories.

D. Qualification Data: For Installer.

E. Maintenance Data: For coiling counter fire doors to include in maintenance manuals to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.3 QUALITY ASSURANCE:

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.

1. Temperature-Rise Limit: Provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

PART 2 - PRODUCTS

2.1 FIRE-RATED COUNTER DOOR ASSEMBLY:

A. Fire-Rated Counter Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ACME Rolling Doors.
b. Alpine Overhead Doors, Inc.
c. Amarr Garage Doors.
d. C.H.I. Overhead Doors.
e. City-Gates.

B. Fire Rating: 3 hours with temperature-rise limit.

C. STC Rating: 27.

D. Curtain R-Value: 5.0 deg F x h x sq. ft./Btu (0.881 K x sq. m/W).

E. Door Curtain Material: Galvanized steel.

F. Door Curtain Slats: Flat profile slats of 1-1/2-inch (38-mm) center-to-center height.

1. Insulated-Slat Interior Facing: Metal.

G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

H. Integral Frame, Hood, and Fascia: Galvanized steel.

1. Mounting: Face of wall.

I. Sill Configuration: Integral metal sill.

J. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: Door shall be secured by means of cylinder locks, operable from sides of coil.

K. Manual Door Operator: Manufacturer's standard crank operator.

1. Provide operator with manufacturer's standard removable operating arm.

L. Curtain Accessories: Equip door with smoke seals, automatic closing device, push/pull handles.

M. Door Finish:

1. Powder-Coated Finish: Color as selected by Designer from manufacturer's full range.

2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION:

A. Door Curtains: Fabricate coiling counter-door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.

2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.

3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

1. Removable Posts and Jamb Guides: Manufacturer's standard.

2.3 HOODS:

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.

2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

2.4 LOCKING DEVICES:

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks, located on both left and right sides, operable from coil side.Retain "Chain Lock Keeper" Paragraph below for chain-hoist-operated doors or emergency chain-hoist operation.

2.5 CURTAIN ACCESSORIES:

A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.

B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

C. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Testing for manually operated doors shall allow resetting by opening the door without retensioning the counterbalancing mechanism. Automatic-closing device shall be designed for activation by the following:

1. Manufacturer's standard UL-labeled heat detector and door-holder-release devices.

2.6 COUNTERBALANCING MECHANISM:

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.

2.7 MANUAL DOOR OPERATORS:

A. General: Equip door with manual door operator by door manufacturer.

B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf (111 N).

C. Crank Operator type.

2.8 GENERAL FINISH REQUIREMENTS:

A. 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.

2.9 STEEL AND GALVANIZED-STEEL FINISHES:

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Fire-Rated Doors: Install according to NFPA 80.

3.3 STARTUP SERVICE:

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING:

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 3 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083313

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Insulated service doors.

B. Related CSI Sections include the following:

1. Division 26 Sections for electrical service and connections for powered operators and accessories.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type and size of overhead coiling door and accessory. Include the following:

1. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

D. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

E. Qualification Data: For qualified Installer.

F. Seismic Qualification Certificates: For overhead coiling doors, accessories, and components, from manufacturer.

G. Maintenance Data: For overhead coiling doors to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

H. Warranties: Sample of special warranties.

1.3 QUALITY ASSURANCE:

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer in accordance with Form 818 Article 1.20-1.06.01

1. Obtain operators and controls from overhead coiling door manufacturer.

C. Sound-Control Doors: Assemblies that have been fabricated and tested to control the passage of sound and have minimum certified STC rating according to ASTM E 413.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Regulatory Requirements: Comply with applicable provisions in ICC/ANSI A117.1.

1.4 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Faulty operation of hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
d. Delamination of exterior or interior facing materials.

2. Warranty Period: Five (5) years from date of Certificate of Compliance.

C. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: Ten (10) years from date of Certificate of Compliance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. General Performance: Coiling doors shall meet performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.

B. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

C. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

1. Fire/Windstorm Classification: Class 1A-105.
2. Hail-Resistance Rating: MH.
3. Approval Category for Wind Zone: HM-SM (hurricane-prone region with small debris impact).
4. Design Loads: Refer to Structural Drawings.
5. Lateral Pressures: Refer to Structural Drawings.
6. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

D. Seismic Performance: Overhead coiling doors and sectional shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. Seismic Component Importance Factor: 1.0.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION:

A. Basis-of-Design Product: Subject to compliance with requirements, provide Model DuraCoil Standard as manufactured by Raynor or an approved equal.

B. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch and as required to meet requirements.
2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.

C. Endlocks and Windlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

D. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from manufacturer's standard hot-dip galvanized steel

E. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

F. Vision Panels: Manufacturer’s standard plexiglass vision panels for insulated flat slats uniformly spaced openings. Reference Door Schedule for dimensions and Building Elevations for graphic representations.

2.3 HOOD:

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
2. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.4 CURTAIN ACCESSORIES:

A. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.

1. At door head, use 1/8-inch thick, replaceable, continuous sheet secured to inside of hood.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch thick seals of flexible vinyl, rubber, or neoprene.

2.5 COUNTERBALANCING MECHANISM:

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.6 ELECTRIC DOOR OPERATORS:

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.
3. Usage Classification: Standard duty, up to 60 cycles per hour.
4. Emergency Manual Operation: Crank type.

5. Control Station: Where shown on plans.
6. Operation Cycles: Not less than 20,000.
7. No entrapment protection elements shall be used (e.g. bottom sensor edge, photo-eye, motion sensors)

B. Door Operator Location(s): Operator location indicated for each door.

1. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.

C. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements, unless otherwise indicated.

1. Electrical Characteristics:

a. Phase: Three phase.
b. Volts: 208 V.
c. Hertz: 60.

2. Motor Type and Controller: Reversible motor and controller for motor exposure indicated.
3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
4. Motor, controller, accessories shall be rated NEMA 4 or 4X in wash bays.
5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
6. Operator Controls/Control Station: Constant-contact, three button control station with push-button controls labeled “Open”, “close”, and “Stop.” User must continuously hold the “Close” button for the door to be lowered. NEMA 4 or 4X in wash bays.

D. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

E. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 30 lbf.

F. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock

device to automatically prevent motor from operating when emergency operator is engaged.

G. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.7 DOOR ASSEMBLY:

A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Series 625 rolling service doors as manufactured by Overhead Door Corporation, or an approved equal.

B. STC Rating: 21.

C. Curtain R-Value: 7.7

D. Door Curtain Material: Galvanized steel.

E. Door Curtain Slats: Flat profile slats of manufacturer’s standard center-to-center height.

F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

G. Hood: Match curtain material and finish.

1. Shape: Round.
2. Mounting: Face of wall.

H. Door Finish:

1. Factory prime finish in the manufacturer's standard color, prior to the application of the powder-coated finish, color as selected by the Designer from manufacturer's full range of color.

2.8 GENERAL FINISH REQUIREMENTS:

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. 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.

2.9 STEEL AND GALVANIZED-STEEL FINISHES:

A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICE:

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING:

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide weathertight fit around entire perimeter.

3.5 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 3 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083323

SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Electrically operated sectional doors.

B. Related CSI Sections:

1. Division 23 Section 230900, “Instrumentation and Control for HVAC” for overhead door contacts.
2. Division 26 Sections for electrical service and connections for powered operators and accessories.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type and size of sectional door and accessory. Include the following:

1. Motors: Show nameplate data and ratings, characteristics, and mounting arrangements

C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

D. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

E. Qualification Data: For qualified Installer.

F. Maintenance Data: For sectional doors to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

G. Warranties: Sample of special warranties

1.3 QUALITY ASSURANCE:

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Testing Agency Qualifications: Qualified according to Florida Building Code Testing Application Standards (TAS) 201 and 203, ASTM standards E1886 and E1996, or ANSI/DASMA 115.

C. Source Limitations: Obtain sectional doors from single source from single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.4 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Faulty operation of hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
d. Delamination of exterior or interior facing materials.

2. Warranty Period: Five (5) years from date of Certificate of Compliance.

C. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: Ten (10) years from date of Certificate of Compliance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. General Performance: Sectional doors shall meet performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.

B. Operation Cycles Requirements: Provide sectional overhead door components and operators capable of operating for not less than 10,000 cycles.

C. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Fire/Windstorm Classification: Class 1A-105.
2. Hail-Resistance Rating: MH.
3. Approval Category for Wind Zone: HM-SM (hurricane-prone region with small debris impact).
4. Design Loads: Refer to Structural Drawings.
5. Lateral Pressures: Refer to Structural Drawings.
6. Factor of Safety: 2.0.
7. Testing: According to Florida Building Code Testing Application Standards (TAS) 201 and 203, ASTM standards E1886 and E1996, or ANSI/DASMA 115.

2.2 STEEL DOOR SECTIONS:

A. Exterior Section Faces and Frames: Fabricate from zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated zinc coating and thickness.

1. Fabricate section faces from single sheets to provide sections not more than 24 inches high and of indicated thickness. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weathertight seal, with a reinforcing flange return.
2. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior and interior faces of door.

B. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.064-inch nominal coated thickness and welded to door section. Provide intermediate stiles formed from not less than 0.064-inch thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches apart.

C. Reinforce bottom section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal.

D. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.

E. Provide reinforcement for hardware attachment.

F. Foamed-in-Place Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free polyurethane insulation, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load, and with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within steel sections that incorporate the following interior facing material, with no exposed insulation:

1. Interior Facing Material: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated thickness.
2. Interior Facing Material: Manufacturer's standard prefinished hardboard panel, 1/8 inch thick and complying with ANSI A135.5.

G. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.

2.3 TRACKS, SUPPORTS, AND ACCESSORIES:

A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances shown on Drawings, and complying with ASTM A 653/A 653M for minimum G60 (Z180) zinc coating. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track spaced 2 inches apart for door-drop safety device. Slope tracks at proper angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.

B. Track Reinforcement and Supports: Galvanized-steel track reinforcement and support members, complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.

1. Vertical Track Assembly: Track with wall jamb brackets attached to track and attached to wall.
2. Horizontal Track Assembly: Track with continuous reinforcing angle attached to track and supported at points from curve in track to end of track by laterally braced attachments to overhead structural members.

C. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of overhead door.

1. Provide motor-operated doors with bottom weatherseal.
2. Provide continuous flexible seals at door jambs for a weathertight installation.

D. Windows: ½" insulated glass window units set in two-piece molded high-impact polymer frames for metal-framed doors. Provide removable stops of same material as door-section frames.

1. Size: Manufacturer's standard for type of glazing indicated.
2. Vision Panels are to be factory installed, made by the door manufacturer for this purpose, and are fully covered under the warranty for the door.

2.4 HARDWARE:

A. General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.

B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges where required, for doors over 14 feet wide unless otherwise recommended by door manufacturer.

C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch diameter roller tires for 3-inch wide track and 2-inch diameter roller tires for 2-inch wide track.

D. Push/Pull Handles: For push-up or emergency-operated doors, provide galvanized-steel lifting handles on each side of door.

E. If door unit is power operated, provide safety interlock switch to disengage power supply when door is locked.

2.5 COUNTERBALANCE MECHANISM:

A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.

B. Weight Counterbalance: Counterbalance mechanism consisting of filled pipe weights that move vertically in a galvanized-steel weight pipe. Connect pipe weights with cable to weight-cable drums mounted on torsion shaft made of steel tube or solid steel.

C. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 14 feet long and two additional brackets at one-third points to support shafts more than 14 feet long unless closer spacing is recommended by door manufacturer.

2.6 ELECTRIC DOOR OPERATORS:

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.
3. Usage Classification: Standard duty, up to 60 cycles per hour.
4. Operator Type: Trolley.
5. Emergency Manual Operation: Chain type.
6. Control Station: Where shown on plans.
7. Operation Cycles: Not less than 10,000.
8. No entrapment protection elements shall be used (e.g. bottom sensor edge, photo-eye, motion sensors)

B. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.

1. Trolley: Trolley operator mounted to ceiling above and to rear of door in raised position and directly connected to door with drawbar.

C. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements unless otherwise indicated.

1. Electrical Characteristics:

a. Phase: Three phase.
b. Volts: As indicated on Electrical Drawings.
c. Hertz: 60 hz.

2. Motor Type and Controller: Reversible motor and controller for motor exposure indicated. NEMA 4 in wash bays.
3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.

4. Motor, controller, accessories shall be rated NEMA 4 or 4X in wash bays.
5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
6. Use adjustable motor-mounting bases for belt-driven operators.
7. Operating Controls/Control Station: Constant-contact, three button control station with push-button controls labeled "Open", "close", and "Stop." User must continuously hold the "Close" button for the door to be lowered. NEMA 4 or 4X in wash bays.

D. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 35 lbf.

E. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

F. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

G. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

2.7 DOOR ASSEMBLY:

A. Steel Sectional Door: Sectional door formed with hinged sections.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Overhead Door Corporation.
b. Raynor.
c. Wayne-Dalton Corp.

B. R-Value: 12.0 deg F x h x sq. ft./Btu.

C. Steel Sections: Zinc-coated (galvanized) steel sheet with G90 (Z275) zinc coating.

1. Section Thickness: 2 inches.
2. Exterior-Face, Steel Sheet Thickness: 0.019-inch nominal coated thickness.

a. Surface: Flat or ribbed to suit manufacturer's standard.

3. Insulation: Foamed in place.
4. Interior Facing Material: Zinc-coated (galvanized) steel sheet of manufacturer's recommended thickness to meet performance requirements nominal coated thickness.

D. Track:

1. Track Size: 3 inches or 2 inches; size shall be chosen based on the structural performance requirements in Section 2.1.A.
2. Configuration: Standard lift.

E. Weatherseals: Fitted to bottom and top and around entire perimeter of door.

F. Windows: Approximately 24 by 11 inches, with curved corners, and spaced apart the approximate distance as indicated on plans; in one row at height indicated on plans; installed with insulated glazing of the following type:

1. Insulating Glass: Manufacturer's standard.

G. Roller-Tire Material: Manufacturer's standard.

H. Locking Devices: Equip door with slide bolt for padlock.

I. Counterbalance Type: Torsion spring.

J. Door Finish:

1. Finish of Interior/Exterior Facing Material: White/Dark Brown.

2.8 GENERAL FINISH REQUIREMENTS:

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Tracks:

1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches apart.
2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
3. Repair galvanized coating on tracks according to ASTM A 780.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Insulate behind control stations mounted on steel.

3.3 STARTUP SERVICES:

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING:

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust doors and seals to provide weathertight fit around entire perimeter.

D. Align and adjust motors, pulleys, belts, sprockets, chains, and controls according to manufacturer's written instructions.

3.5 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 3 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes per schedule operable aluminum-framed windows for exterior locations.

B. Related CSI Sections include the following:

1. Division 08 Section 088000, "Glazing" for glazing of windows.

1.2 DEFINITIONS:

A. Performance class designations according to AAMA/WDMA/CSA 101/I.S.2/A440:

1. AW.

B. Performance grade number according to AAMA/WDMA/CSA 101/I.S.2/A440:

1. Design pressure number in pounds force per square foot used to determine the structural test pressure and water test pressure.

C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.

D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.3 PERFORMANCE REQUIREMENTS:

A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size indicated below:

1. Size indicated on plans in window schedule.

B. Structural Performance: Provide aluminum windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA/CSA 101/I.S.2/A440, Uniform Load Structural Test:

1. Structural Performance: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on plans.

    a. Fire/Windstorm Classification: Class 1A-105.
    b. Hail-Resistance Rating: MH.
    c. Approval Category for Wind Zone: HM-SM (hurricane-prone region with small debris impact).
    d. Design Loads: Refer to Structural Drawings.

2. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on testing performed according to AAMA/WDMA/CSA 101/I.S.2/A440, Uniform Load Deflection Test or structural computations.

C. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F (material surfaces.

1.4 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

C. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:

1. Mullion details, including reinforcement and stiffeners.
2. Joinery details.
3. Expansion provisions.
4. Flashing and drainage details.
5. Weather-stripping details.
6. Thermal-break details.
7. Glazing details.
8. Window cleaning provisions.

9. Window System Operators: Show locations, mounting, and details for installing operator components and controls.
10. For installed products indicated to comply with design loads, include structural analysis data prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of aluminum windows and used to determine the following:

    a. Structural test pressures and design pressures from wind loads indicated.
    b. Deflection limitations of glass framing systems.

D. Samples for Initial Selection: For units with factory-applied color finishes.

1. Include similar Samples of hardware and accessories involving color selection.

E. Product Schedule: For aluminum windows. Use same designations indicated on plans.

F. Quality Assurance Submittals:

1. Qualification Data: For Installer, manufacturer, professional engineer and testing agency.
2. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.
3. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

G. Maintenance Data: For operable window sash, operating hardware, weather stripping, and finishes to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE:

A. Source Limitations: Obtain aluminum windows through one source from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.

C. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

D. Product Testing: Test aluminum windows using a qualified testing agency.

E. Product Options: Contract establishes requirements for aluminum windows' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

F. Fenestration Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440, "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors," for definitions and minimum standards of performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.

1. Provide AAMA, WDMA-certified aluminum windows with an attached label.

G. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

1.6 PROJECT CONDITIONS:

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.7 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
c. Faulty operation of movable sash and hardware.
d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Window: Manufacturer's standard, but not less than 5-years from the issuance of the Certificate of Compliance.
b. Metal Finish: 10 years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. EFCO Corporation.
2. Kawneer; an Alcoa Company.
3. Wausau Window and Wall Systems.
4. Winco Window Company.

2.2 MATERIALS:

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength, not less than 16,000-psi minimum yield strength, and not less than 0.062-inch thickness at any location for the main frame and sash members.

B. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.

1. Reinforcement: Where fasteners screw anchor into aluminum less than 0.125 inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.
2. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-

coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

E. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when aluminum window is closed.

1. Weather-Stripping Material: Elastomeric cellular preformed gaskets complying with ASTM C 509.

F. Sliding-Type Weather Stripping: Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701/702.

1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.

G. Replaceable Weather Seals: Comply with AAMA 701/702.

H. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

I. Mullion covers; trim pieces, head, jamb, and sill extenders: Provide window manufacturer's standard components if shown on the plans.

2.3 WINDOW:

A. Window Type: As indicated on plans

B. AAMA/WDMA Performance Requirements: Provide aluminum windows of performance indicated that comply with AAMA/WDMA/CSA 101/I.S.2/A440 unless more stringent performance requirements are indicated.

1. Performance Class and Grade: AW40.

C. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 60.

D. Thermal Transmittance: Provide aluminum windows with a whole-window, U-factor maximum indicated at 15-mph exterior wind velocity and winter condition temperatures when tested according to AAMA 1503.

1. U-Factor: 0.40 Btu/sq. ft. x h x deg F or less.

E. Solar Heat-Gain Coefficient (SHGC): Provide aluminum windows with a whole-window SHGC maximum of 0.55, determined according to NFRC 200 procedures.

F. Sound Transmission Class (STC): Provide glazed windows rated for not less than 26 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

G. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA/CSA 101/I.S.2/A440, Air Infiltration Test.

1. Maximum Rate: 0.1 cfm/sq. ft. of area at an inward test pressure of 6.24 lbf/sq. ft..

H. Water Resistance: No water leakage as defined in AAMA/WDMA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA/CSA 101/I.S.2/A440, Water Resistance Test.

1. Test Pressure: 15 percent of positive design pressure, but not less than 2.86 lbf/sq. ft. or more than 15 lbf/sq. ft..

I. Life-Cycle Testing: Test according to AAMA 910 and comply with AAMA/WDMA/CSA 101/I.S.2/A440.

J. Operating Force and Auxiliary (Durability) Tests: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for operating window types indicated.

2.4 GLAZING:

A. Glass and Glazing Materials: Refer to CSI Division 08 Section 088000, "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.

2.5 HARDWARE:

A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide nonmagnetic stainless steel.

B. Sill Cap/Track: Extruded-aluminum track with natural anodized finish, of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.

C. Locks and Latches: Designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.

D. Roller Assemblies: Low-friction design.

E. Push-Bar Operators: Provide telescoping-type, push-bar operator designed to open and close ventilators with fixed screens.

F. Gear-Type Rotary Operators: Comply with AAMA 901 when tested according to ASTM E 405, Method A.

1. Operation Function: All ventilators move simultaneously and securely close at both jambs without using additional manually controlled locking devices.

G. Four- or Six-Bar Friction Hinges: Comply with AAMA 904.

1. Locking mechanism and handles for manual operation.
2. Friction Shoes: Provide friction shoes of nylon or other nonabrasive, nonstaining, noncorrosive, durable material.

H. Limit Devices: Provide limit devices designed to restrict sash or ventilator opening.

1. Safety Devices: Limit clear opening to 6 inches for ventilation; with custodial key release.

I. Pole Operators: Tubular-shaped anodized aluminum; with rubber-capped lower end and standard push-pull hook at top to match hardware design; of sufficient length to operate window without reaching more than 60 inches above floor; 1 pole operator and pole hanger per room that has operable windows more than 72 inches above floor.

J. Casement Windows: Provide the following operating hardware:

1. Operator: Gear-type rotary single-arm operator located on jamb at sill.

a. Rating: Provide rotary operator rated AW40 according to AAMA 901.
b. Handle: Standard crank.

2.6 INSECT SCREENS:

A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on inside of window and provide for each operable exterior sash or ventilator.

1. Aluminum Tubular Frame Screens: Comply with SMA 1004, "Specifications for Aluminum Tubular Frame Screens for Windows,"Architectural C-24 class.

B. Aluminum Insect Screen Frames: Manufacturer's standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.

1. Aluminum Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet with minimum wall thickness as required for class indicated.

2. Extruded-Aluminum or Aluminum Tubular Framing Sections and Cross Braces: Not less than 0.040-inch wall thickness.
3. Finish: Match aluminum window members.

C. Glass-Fiber Mesh Fabric: 18-by-14 or 18-by-16 mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration; in the following color. Comply with ASTM D 3656.

1. Mesh Color: Charcoal gray.

2.7 FABRICATION:

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.

C. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.

1. Provide thermal-break construction that has been in use for not less than three years and has been tested to demonstrate resistance to thermal conductance and condensation and to show adequate strength and security of glass retention.
2. Provide thermal barriers tested according to AAMA 505; determine the allowable design shear flow per the appendix in AAMA 505.
3. Provide hardware with low conductivity or nonmetallic material for hardware bridging thermal breaks at frame or vent sash.

D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.

1. Vertically Pivoted Windows: Provide double-row weather stripping.

E. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

F. Provide water-shed members above side-hinged ventilators and similar lines of natural water penetration.

G. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal

expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

H. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inchthick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units. Provide subframes capable of withstanding design loads of window units.

I. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in CSI Division 08 Section 088000, "Glazing" and with AAMA/WDMA/CSA 101/I.S.2/A440.

J. Glazing Stops: Provide snap-on glazing stops coordinated with CSI Division 08 Section 088000, "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

2.8 FINISHES, GENERAL:

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES:

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

1. Color: Dark bronze.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.

1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Comply with plans, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL:

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.

2. Air-Infiltration Testing:

   a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 in Part 1.3 "Performance Requirements".
   b. Allowable Air-Leakage Rate: 1.5 times the test pressures to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 in Part 1.3 “Performance Requirements” rounded down to one decimal place.

3. Water-Resistance Testing:

   a. Test Pressure: Two-Thirds times the test pressures required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 in Part 1.3 “Performance Requirements”.
   b. Allowable Water Infiltration: No water penetration.

4. Testing Extent: Three windows as selected by the Engineer and a qualified independent testing and inspecting agency. Windows shall be tested immediately after installation.
5. Test Reports: Shall be prepared according to AAMA 502.

C. Remove and replace noncomplying aluminum window and retest as specified above.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 ADJUSTING, CLEANING, AND PROTECTION:

A. Adjust operating sashes and ventilators, screens, hardware, operators, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 085113

SECTION 085123 - STEEL WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel windows from cold-formed steel members.

B. Related CSI Sections:

1. Division 07 Section 079200, "Joint Sealants" for sealing perimeter joints between windows and adjacent materials.
2. Division 08 Section 088000, "Glazing" for glazing requirements for steel windows.
3. Division 09 Section 099123, “Interior Painting” for on-site painting of factory prime-coated windows.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.

C. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:

1. Layout and installation details, including anchors.
2. Elevations of continuous work at 1/4 inch = 1 foot (1:50) scale and typical window unit elevations at 3/4 inch = 1 foot (1:20) scale.
3. Full-size section details of typical composite members, including reinforcement.
4. Glazing details.

D. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for steel window manufacturer's standard products to determine compliance with performance requirements.

1.3 QUALITY ASSURANCE:

A. Fire-Test-Response Characteristics: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated on Drawings, based on testing indicated.

1. Neutral-Pressure Test: UL 9.
2. Positive-Pressure Test: NFPA 257 conducted so that within the first 10 minutes of test, furnace pressure is adjusted to place at least two-thirds of the test specimen above the neutral-pressure plane and to maintain this plane for the balance of test.
3. Fire-Protection Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
4. Provide steel windows labeled with appropriate markings of applicable testing and inspecting agency.

B. SWI Publication: Comply with applicable requirements in SWI's "The Architect's Guide to Steel Windows and Doors" except where more stringent requirements are indicated.

1.4 PROJECT CONDITIONS:

A. Field Measurements: Verify actual dimensions of steel window openings by field measurements before fabrication and indicate on shop drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating steel windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cold-Formed Steel Windows:

a. D.V. Fyre-Tec, Inc.
b. Optimum Window Manufacturing Corp.

2.2 MATERIALS:

A. Cold-Formed Steel Window Members: Provide frame and ventilator members mechanically formed from metallic-coated, low-carbon, cold-rolled steel sheet complying with ASTM A 653/A 653M. For combined weight of frame and ventilator members and front-to-back depth of frame or ventilator members, comply with the following requirements:

1. Commercial and Industrial Windows: Not less than 2.75 lb/ft. in combined weight, and not less than 1-1/4 inches deep.

B. Glazing beads shall be manufacturer's standard**.**

C. Fasteners: Provide fasteners of bronze, brass, stainless steel, or other metal that are warranted by manufacturer to be noncorrosive and compatible with trim, hardware, anchors, and other components of steel windows.

1. Exposed Fasteners: If exposed fasteners are used, provide Phillips flat-head machined screws that match finish of member or hardware being fastened, as appropriate.

D. Anchors, Clips, and Window Accessories: Provide units of stainless steel, hot-dip zinc-coated steel, bronze, brass, or iron complying with ASTM A 123/A 123M. Provide units with sufficient strength to withstand design pressure indicated.

E. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when steel window is closed.

1. Weather-Stripping Material: Elastomeric, cellular, preformed gaskets complying with ASTM C 509.
2. Weather-Stripping Material: Dense elastomeric gaskets complying with ASTM C 864.
3. Weather-Stripping Material: Manufacturer's standard.

F. Sealant: For sealants required within fabricated windows, provide manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 GLAZING:

A. Glass and Glazing System: See CSI Division 08 Section 088000, "Glazing" for fire resistance rated glass units and glazing requirements for steel windows.

2.4 ACCESSORIES:

A. General: Provide manufacturer's standard accessories that comply with indicated standards.

2.5 FABRICATION:

A. General: Fabricate steel windows of type and in sizes indicated to comply with SWI standards. Include a complete system for assembly of components and anchorage of window units.

1. Provide units that are reglazable without dismantling ventilator framing.
2. Prepare window ventilators for glazing.

B. Mullions: Formed of cold-formed steel matching window units; with anchors for support to structure and for installation of window units and having sufficient strength to withstand design pressure indicated. Provide mullions of profile indicated and with cover plates. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections.

C. Glazing Stops: Provide screw-applied glazing stops; coordinate with CSI Division 08 Section 088000, "Glazing" and with glazing system indicated. Provide glazing stops to match panel frames. Finish glazing stops to match window units if fabricated of steel; otherwise, provide manufacturer's standard finish.

2.6 STEEL FINISHES:

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Surface Preparation: Clean surfaces of dirt, oil, grease, scale, and other contaminants; follow with a zinc-phosphate pretreatment applied according to window manufacturer's written recommendations.

C. Shop Prime Coat Finish: After fabrication, provide manufacturer's standard epoxy prime coat of 1.0-mil dry film thickness, and oven dry for 30 minutes at 300 deg F.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor

retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.

1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ADJUSTING, CLEANING, AND PROTECTION:

A. Clean factory-finished steel surfaces immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Avoid damaging protective coatings and finishes.

B. Clean glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. Remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 085123

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes items known commercially as finish or door hardware that are required for swing doors, except special types of unique and non-matching hardware specified in the same sections as the door and door frame. The extent of the door hardware required is indicated on the plans and in the schedules. Furnish all miscellaneous items of hardware specified or required for operations indicated and not otherwise specified.

B. This Section also includes a Knox-Box.

C. ConnDOT has a Statewide System of Master Ring Locks using Corbin-Russwin jumbo-sized housings and a Medeco Keymark small format interchangeable core lock system.

D. Related CSI Sections include the following:

1. Division 08 Section 081113, "Hollow Metal Doors and Frames" for metal swing doors and hollow metal frames. Silencers included integral with hollow metal frames specified with door frames.
2. Division 09 Section 099123, “Interior Painting” and 099113, “Exterior Painting” for painting and finishing of metal doors and frames.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR-SUBMITTALS.

B. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

1. Hardware supplier shall indicate on all catalog cuts, which specified items are equal to those submitted for approval as equal.

C. Final Hardware Schedule: Coordinate Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:

a. Type, style, function, size, and finish of each hardware item.
b. Name and manufacturer of each item.

c. Fastenings and other pertinent information.
d. Location of each hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.
e. Explanation of all abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for hardware.
g. Door and frame sizes and materials.
h. Keying information.

D. Submittal Sequence: Submit initial draft of schedule with essential product data at earliest possible date in order to facilitate the fabrication of other work (e.g., hollow metal frames) which is critical in the Project construction schedule. Submit final draft of schedule after samples, product data, coordination with shop drawings of other work affected by door hardware, delivery schedules, and similar information has been completed and accepted.

E. Templates: Templates for hardware being supplied shall be provided by Hardware Supplier to the Door Manufacturers and Suppliers.

F. Maintenance Data: For door hardware to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.3 QUALITY ASSURANCE:

A. Obtain each type of hardware, except cylinders (latch and lock sets, hinges, closers, etc.) from a single manufacturer.

B. Supplier: A recognized architectural door hardware supplier who has been furnishing hardware in the project's vicinity for a period of not less than two (2) years, and who is, or who employs, an experienced architectural hardware consultant who is available, at reasonable times during the course of the Work, for consultation about project's hardware requirements, to Engineer and Contractor.

C. All hardware shall meet applicable State, UL, and ADA/ADAAG/ANSI requirements.

D. All finish hardware shall meet the Americans Standard Institute Certification for a Grade 1 product.

E. FireRated Openings: Provide hardware for firerated openings that complies with NFPA 80 and local building code requirements. Provide only hardware which has been tested and listed UL or FMG for types and sizes of doors required and complies with requirements of firerated door and door frame labels.

1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL or FMG labels indicating "Fire Door to be equipped with Fire Exit Hardware") provide UL or FMG label on exit devices indicating "Fire Exit Hardware."

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.

B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.

C. Inventory door hardware jointly with representative of hardware supplier and hardware installer until each is satisfied that count is correct.

D. Deliver individually packaged door hardware items promptly to place of installation (shop or Project Site).

E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Items of hardware not specifically mentioned herein but necessary for the completion of the work shown on the plans shall be provided. Such items shall be of type and quality suitable for the required service and comparable to and matching adjacent hardware.

B. Where size and type of openings is such as to prevent the use of the types specified, hardware shall be furnished of suitable type, having as near as practicable the same operation quality as specified type; size shall be adequate for required service and comparable to and matching adjacent hardware.

C. ANSI/BHMA/FS designations used elsewhere in this Section are derived from the following standards. Provide products complying with these standards and requirements specified elsewhere in this Section.

1. Butts and Hinges: BHMA A156.1-97 (ANSI) (FS FF-H-116C).
2. Locks and Lock Trim: BHMA A156.2 –96 (ANSI) (FS FF-H-1068).
3. Exit Devices: BHMA A156.3. –94 (ANSI).
4. Door Controls-Closers: BHMA A156.4 –92 (ANSI) (FS FF-H-121C).
5. Auxiliary Locks: BHMA A156.5-92 (ANSI).
6. Architectural Door Trim: BHMA A156.6 -94 (ANSI).
7. Template Hinge Dimensions: BHMA A156.7-88(ANSI)

8. Mortise Locks and Latches: BHMA A156.13 –94 (ANSI).
9. Closer Holder Release Devices: BHMA A156.15 -95(ANSI).
10. Auxiliary Hardware: BHMA A156.16 -89 (ANSI) (FS FF-H-11A).
11. Materials and Finishes: BHMA A156.18 -93(ANSI).

2.2 MATERIALS AND FABRICATION:

A. General:

1. Hand of Door: Plans show direction of swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
2. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates.) except in conjunction with required UL labels and as otherwise acceptable to the Engineer.

B. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's name standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156.10 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

C. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for selftapping sheet metal screws.

D. Furnish screws for installation with each hardware item. Provide Phillips flathead screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible, including "prepared for paint" surfaces to receive painted finish.

E. Provide sex bolts for all door closer installations on the doors. All door closer arms to use machine screws. No self tapping fasteners are allowed on any hardware.

2.3 HARDWARE FINISHES:

A. Provide matching finishes for hardware units at each door or opening, to the greatest extent possible, and except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer's standard finish for the latch and lock set(or push-pull units if no latch or locks sets) for color and texture.

B. All hardware shall have a US26D (BHMA 626) finish unless indicated otherwise. Hardware specified to be stainless steel shall have a US32D (BHMA 630) finish.

C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

2.4 HINGES, BUTTS AND PIVOTS:

A. Templates: Provide only template-produced units.

B. Screw: Provide Phillips flat-head or machine screws for installation of units. Finish screw heads to match surface of hinge or pivots.

C. Butt Hinges:

1. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

a. Steel Hinges (Satin Finish): Steel pins, ball bearing with non-removable pins for interior doors.
b. Non-ferrous Hinges: Stainless steel pins, ball bearing with non-removable pins for exterior doors.
c. Tips: Flat button and matching plug, finished to match leaves.

2. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges per door leaf for doors 90 inches or less in height and one additional hinge for each 30 inches of additional height
3. Butt Hinges shall be 4 1/2" x 4 1/2" unless otherwise indicated.

D. Available Products: Subject to compliance with specification requirements, Butt Hinges that may be incorporated into the work include, but are not limited to the following.

1. Butt Hinges: Stanley Model No. FBB-179, FBB-191.

2.5 MORTISE LOCKSETS, LATCHSETS AND CYLINDERS:

A. General: Supplier will meet with Engineer to finalize keying requirements and obtain final instructions in writing.

1. All locks to have 2-3/4” backset.
2. All strikes ASA Prep.
3. All doors to receive locksets and latchsets require special trim preparation to accept Master Ring Housings.

B. All locksets to be Corbin Russwin ML2000 Series, function ML2051 with NSM lever trim, except for the women’s restroom which shall be function ML2030 with NSM lever trim. All locksets to be Master Ring Style.

C. All latchsets shall be Corbin Russwin ML2000 Series function 2010 with NSM lever trim.

D. All Master Ring cylinder housings to be Medeco Keymark 33K076028 that will accept a 7 pin core.

E. Corbin Russwin Master Ring Collar 447F44 to be furnished

2.6 KEYING:

A. Temporary 7 pin cores shall be furnished and installed by the contractor for all locks. Cores to be 626 finish in the Best / Falcon "A" keyway. Cores to be keyed 1335331 for an operating key and operated by a control key of 4118114.

B. One control key and one operating key shall be forwarded to Mr. David A. Hartley at The Connecticut Department of Transportation 2800 Berlin Turnpike, Newington, CT. 06111. Ten (10) operating keys are to be forwarded to the Engineer.

C. Contractor shall furnish for every temporary keyed core supplied, plus 10% more, a Medeco 6D99 Keymark 7 Pin US26D core, uncombinated, that the state will perform final keying on. Provide uncombinated permanent cores 90 days prior to completion of the project. Coordinate with the Engineer prior to installation.

2.7 LOCKS, LATCHES AND BOLTS:

A. Strikes: Provide dust-proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.

B. Electric Strikes: Provide UL listed electric strikes tested in accordance with ANSI156.5 Grade 1. Electric strikes shall be constructed of stainless steel, non-handed, Fail Secure, and of the voltage specified on the electrical drawings. Provide Electric Strikes and Panic/Fire Exit Devices from the same manufacturer.

C. Lock Throw: Provide 5/8-inch minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch on rated fire openings.

D. Flush Bolt Heads: Minimum of 1/2inchdiameter rods of brass, bronze, or stainless steel with minimum 12" long rod for doors up to 7'0" in height. Provide longer rods as necessary for doors exceeding 7'0" in height.

E. Available Products: Subject to compliance with specification requirements, provide Electric Strikes from the following manufacturer or an approved equal:

1. Von Duprin: Series 6111

2.8 CLOSERS AND DOOR CONTROL DEVICES:

A. Size of Units: Except as otherwise specifically indicated, comply with the recommendations of the DHI for size of door control unit depending on size of door, exposure to weather, and anticipated frequency of use. Provide suitable brackets to suit job conditions.

B. All Door Closers shall comply with the following:

1. Door Closer shall be a premium graded handed and individual sized door closer. Universal non-handed and sized closers shall not be used. Closers having dual spindles for both left and right hands shall not be used.
2. Closer shall be fully hydraulic, full rack and pinion construction, having a high strength cast iron cylinder.
3. Door Closer shall have separate valves for backcheck, closing speed and latching speed.
4. Provide closer with a standard case cover.
5. All exterior door closures shall be provided with parallel arms with a cast in stop on the closure shoe.
6. Finish shall be sprayed SBL.

C. All closers shall be mounted on doors, except where otherwise detailed. Drop brackets to be supplied where necessary. All door mounting shall be done with sex bolts.

D. AccessFree Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped, provide adjustable units complying with ANSI A117.1 provisions for door opening force and delayed action closing.

E. Available Products: Subject to compliance with specification requirements, Closers that may be incorporated into the work include, but are not limited to the following:

1. Closers: LCN Model 4110

2.9 DOOR TRIM UNITS:

A. Fasteners: Provide exposed fasteners for door trim units (kick plates and similar units) consisting of machine screws. US32 Stainless Steel is required.

B. Fabricate protection plates (armor, kick or mop) not more than 11/2" less than door width on stop side and not more than 1/2" less than door width on pull side by a minimum of 8" in height. Metal Plates shall be stainless steel, 0.050" (U.S. 18 gage).

2.10 WEATHERSTRIPPING:

A. General: Except as otherwise indicated, provide continuous weather-stripping at each edge of every exterior door leaf. Provide type, sizes and profiles shown or scheduled. Provide noncorrosive Stainless Steel fasteners.

B. Astragals for exterior doors shall be Pemko #18061D-NB or approved equal.

C. Weather-stripping for jambs of exterior doors shall be Pemko #309DP or approved equal.

D. Weather-stripping at door bottoms shall consist of design and size similar to Pemko #309DP or approved equal.

E. Rain Drips shall be Pemko #346D or approved equal where called for in the schedule. Finish subject to change based on Designer's selection of door frame color and siding color selected.

2.11 THRESHOLDS:

A. General: Except as otherwise indicated, provide standard metal threshold unit of type, size, and profile as shown or scheduled.

B. Thresholds as called for in the hardware sets shall be Pemko #170A, 2565, 274A, 2746 and 2548A or approved equal.

2.12 EXIT DEVICES:

A. Panic Exit Devices: Panic exit devices where called for in the schedule, shall be a rim type. All panic devices shall be UL listed for safety as panic hardware. All panic devices shall meet ANSI A156.3, Grade 1. Painted finishes are not acceptable. Master Ring cylinder housings as specified are required on all devices. Panic devices shall be push bar style; cross bar styles are not acceptable. All devices shall have cast escutcheons and lever trim (wrought not allowed) and a deadlocking feature on the latch bolt. All devices to have roller strikes. Note: Special trim preparation is required to accept Master Ring Housings

B. Fire Exit Devices: Fire exit devices where called for in the schedule or required by code, shall be a rim type unless otherwise indicated. All fire exit devices shall be UL listed as "Fire Exit Hardware". Painted finishes are not acceptable. Master Ring housings as specified are required on all devices. Fire exit devices shall be push bar style; cross bar styles are not acceptable. All devices shall have cast escutcheons and lever trim (wrought not allowed) and a deadlocking feature on the latch bolt. All devices to have roller strikes. Note: Special trim preparation is required to accept Master Ring Housings.

C. Available Products: Subject to compliance with specification requirements, Exit Devices that may be incorporated into the work include, but are not limited to the following:

1. Panic Exit Devices: Von Duprin Model 99L, Von Duprin Model 99EO.
2. Fire Exit Devices: Von Duprin Model 99L-F

D. Rim Master Ring Exit device cylinder housings. All Rim cylinder housings are to be Medeco Keymark 33K076048 that will accept a 7 pin core. Corbin Russwin Master Ring Collar 255F54 and Backplate 135F10-8 to be furnished with cylinder. See Part 2.6 for keying requirements.

2.13 STOPS AND DOOR HOLDERS:

A. Wall stops shall be provided for all doors and shall meet ANSI A156.16 L02101; suitable expansion shields shall be provided for securing stops to materials other than wood. US32D Stainless Steel is required.

B. Wall Bumpers shall be Ives WS406CVX or approved equal.

C. Lever door holders shall be provided for interior doors only.

1. Basis of design: Grainger Model No. 33J799.
2. Location: Non-fire-rated, interior doors only.
3. Finish: Match door hardware finish.

2.14 KNOX-BOX:

A. Knox-Box: Surface-mounted box with hinged door, without tamper switches, as manufactured by the Knox Company, Model No, 3200 unless an alternate model is required by the local fire marshal, to be installed as directed by the Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Mounting hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by DHI, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Engineer.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in CSI Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of GE-Silicone or polyisobutylene mastic sealant.

F. Weather-stripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

1. Rain Drips shall extend the full width of frame at heads of doors.

G. Electric Strike: Door and Frame shall be prepared to receive electric strike.

H. Knox-Box: Install on chain link gate in accordance with the plans and the manufacturer's installation instructions.

3.2 ADJUSTING, CLEANING, AND DEMONSTRATING:

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.

1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors.

B. Clean adjacent surfaces soiled by hardware installation.

C. Instruct Engineer in the proper adjustment and maintenance of door hardware and hardware finishes.

D. Six Month Adjustment: Approximately six months after the issuance of Certificate of Compliance, the Installer, accompanied by representatives of the manufacturers of latch sets and locksets and of door control devices, and of other major hardware suppliers, shall return to the Project to perform the following work:

1. Examine and readjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.
2. Consult with and instruct Engineer in recommended additions to the maintenance procedures.
3. Replace hardware items that have deteriorated or failed due to faulty design, materials, or installation of hardware units.

4. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.3 HARDWARE SCHEDULE:

A. General: Provide hardware for each door to comply with requirements of this Section, hardware set numbers indicated in door schedule, and in the following schedule of hardware sets.

B. Hardware Set No. 1: Exterior Doors.

1-1/2 pair Butts - Stanley FBB-191.
1 Temporary Core as specified.
1 Cylinder Housing – Medeco Keymark 33K076048, Corbin/Russwin Master Ring Collar 255F54 and Backplate 135F10-8.
1 Panic Exit Device – Von Duprin 99L w/ outside lever trim
1 Automatic Closer - LCN 4110 Series.
1 Kick Plate - 18 ga. stainless steel w/ stainless steel fasteners.
1 set Weatherstripping - Pemko 309DP-PG jamb / top, 309DP-DB bottom, 346D rain drip.
Repair Facility: 1 8" wide Threshold - Pemko 2548A.
Maintenance Facility Office Core: 1 6” wide Threshold – Pemko 2746.
Maintenance Facility Bay Areas: 1 8" wide Threshold - Pemko 2548A.

C. Hardware Set No. 2: Fire Doors.

1-1/2 pair Butts - Stanley FBB-179.
1 Temporary Core as specified.
1Cylinder Housing – Medeco Keymark 33K076048, Corbin/Russwin Master Ring Collar 255F54 and Backplate 135F10-8.
1 Fire Exit Device – Von Duprin 99L-F, w/ outside lever trim.
1 Automatic Closer - LCN 4110 Series.
1 Kick Plate - 18 ga. stainless steel w/ stainless steel fasteners.
1 Door Stop – Ives WS406CVX.
Repair Facility: 1 8" wide Threshold - Pemko 2548A.
Maintenance Facility: 1 6” wide Threshold – Pemko 2746.

D. Hardware Set No. 3: Interior Office Doors.

1-1/2 pair Butts - Stanley FBB-179.
1 Temporary Core as specified.
1 Cylinder Housing – Medeco Keymark 33K076028, Corbin/Russwin Master Ring Collar 447F44.
1 Automatic Closer - LCN 4110 Series.
1 Lockset - Corbin/Russwin ML2000 Series, Function 2051 w/ NSM Lever Trim.
1 Kick Plate - 18 ga. stainless steel w/ stainless steel fasteners.

1 Door Stop – Ives WS406CVX.

E. Hardware Set No. 4: Janitor's Door.

1-1/2 pair Butts - Stanley FBB-179.
1 Temporary Core as specified.
1 Cylinder Housing – Medeco Keymark 33K076028, Corbin/Russwin Master Ring Collar 447F44.
1 Automatic Closer - LCN 4110 Series.
1 Lockset - Corbin/Russwin ML2000 Series, Function 2051 w/ NSM Lever Trim.
1 Kick Plate - 18 ga. stainless steel w/ stainless steel fasteners.
Repair Facility: 1 6" wide Threshold – Pemko 272.
Maintenance Facility: 1 4" wide Threshold - Pemko 274A.

F. Hardware Set No. 5: Mechanical Room Door.

3 pair Butts - Stanley FBB-191.
1 Temporary Core as specified.
1 Cylinder Housing – Medeco Keymark 33K076048, Corbin/Russwin Master Ring Collar 255F54 and Backplate 135F10-8.
2 Automatic Closers - LCN 4110 Series.
1 Panic Exit Device – Von Duprin 99L, w/ outside lever trim.
1 Kick Plate - 18 ga. stainless steel w/ stainless steel fasteners.
1 set Weatherstripping - Pemko 309DP-PG jamb / top, 309DP-DB bottom, 346D rain drip.
2 Astragals – Pemko #18061D-NB.
1 8" wide Threshold - Pemko 2548A.
1 top and bottom Flush Bolt (inactive leaf)

G. Hardware Set No. 6: Men's Room Door.

1-1/2 pair Butts - Stanley FBB-179.
1 Automatic Closer - LCN 4110 Series.
1 Latchset - Corbin/Russwin ML2000 Series, Function 2010 w/ NSM Lever Trim.
1 Kick Plate - 18 ga. stainless steel w/ stainless steel fasteners.
Repair Facility: 1 4" wide Threshold – Pemko 274A.
Maintenance Facility: N/A
1 Door Stop – Ives WS406CVX.

H. Hardware Set No. 7: Wash Bay Interior Doors.

1-1/2 pair Butts - Stanley FBB-179.
1 Automatic Closer - LCN 4110 Series.
1 Panic Exit Device – Von Duprin 99L, w/ outside lever trim.
1 Kick Plate - 18 ga. stainless steel w/ stainless steel fasteners.

1 set Weatherstripping - Pemko 309DP-PG jamb / top, 309DP-DB bottom, 346D rain drip.
1 8" wide Threshold - Pemko 2548A.

I. Hardware Set No. 8: Women's Room Door.

1-1/2 pair Butts - Stanley FBB-179.
1 Automatic Closer - LCN 4110 Series.
1 Lockset - Corbin/Russwin ML2000 Series, Function 2030 w/ NSM Lever Trim.
1 Kick Plate - 18 ga. stainless steel w/ stainless steel fasteners.
Repair Facility: 1 4" wide Threshold – Pemko 274A.
Maintenance Facility: N/A
1 Door Stop – Ives WS406CVX.

J. Hardware Set No. 9: Vestibule Interior Door.

1-1/2 pair Butts - Stanley FBB-179.
1 Temporary Core as specified.
1 Cylinder Housing – Medeco Keymark 33K076048, Corbin/Russwin Master Ring Collar 447F44 and Backplate 135F10-8.
1 Fire Exit Device – Von Duprin 99L-F, w/ outside lever trim.
1 Automatic Closer - LCN 4110 Series.
1 Kick Plate - 18 ga. stainless steel w/ stainless steel fasteners.
1 Door Stop – Ives WS406CVX.
1 Electric Strike – Stainless Steel, non-handed, Fail Secure.

K. Hardware Set No. 10: Conference Room Exterior Door.

1-1/2 pair Butts - Stanley FBB-191.
1 Panic Exit Device – Von Duprin 99EO.
1 Automatic Closer - LCN 4110 Series.
1 Kick Plate - 18 ga. stainless steel w/ stainless steel fasteners.
1 set Weatherstripping - Pemko 309DP-PG jamb / top, 309DP-DB bottom, 346D rain drip.
Repair Facility: 1 8" wide Threshold - Pemko 2548A.
Maintenance Facility: 1 6" wide Threshold – Pemko 2746.

L. Hardware Set No. 11: Cot Room Doors.

3 pair Butts - Stanley FBB-179.
1 Temporary Core as specified.
1 Cylinder Housing – Medeco Keymark 33K076048, Corbin/Russwin Master Ring Collar 255F54 and Backplate 135F10-8.
2 Automatic Closers - LCN 4110 Series.
1 Lockset - Corbin/Russwin ML2000 Series, Function 2051 w/ NSM Lever Trim.

M. Hardware Set No. 12: Electrical Room Door.

1-1/2 pair Butts - Stanley FBB-191.
1 Temporary Core as specified.
1 Cylinder Housing – Medeco Keymark 33K076048, Corbin/Russwin Master Ring Collar 255F54 and Backplate 135F10-8.
1 Automatic Closer - LCN 4110 Series.
1 Lockset - Corbin/Russwin ML2000 Series, Function 2051 w/ NSM Lever Trim.
1 Kick Plate - 18 ga. stainless steel w/ stainless steel fasteners.
Repair Facility: 1 8" wide Threshold - Pemko 2548A.
Maintenance Facility: 1 6" wide Threshold – Pemko 2746.

N. Hardware Set No. 13: Stores Double Door.

3 pair Butts - Stanley FBB-179.
1 Temporary Core as specified.
1 Cylinder Housing – Medeco Keymark 33K076048, Corbin/Russwin Master Ring Collar 255F54 and Backplate 135F10-8.
1 Fire Exit Device – Von Duprin 99L-F, w/ outside lever trim.
2 Automatic Closers - LCN 4110 Series.
2 Kick Plates - 18 ga. stainless steel w/ stainless steel fasteners.
1 Door Stop – Ives WS406CVX.
1 8" wide Threshold - Pemko 2548A.
1 top and bottom Flush Bolt (inactive leaf)

O. Hardware Set No. 14: Lube Room Double Door.

3 pair Butts - Stanley FBB-179.
1 Temporary Core as specified.
1 Cylinder Housing – Medeco Keymark 33K076048, Corbin/Russwin Master Ring Collar 255F54 and Backplate 135F10-8.
1 Fire Exit Device – Von Duprin 99L-F, w/ outside lever trim.
2 Automatic Closers - LCN 4110 Series.
2 Kick Plates - 18 ga. stainless steel w/ stainless steel fasteners.
1 Door Stop – Ives WS406CVX.
1 8" wide Threshold - Pemko 2548A.
1 top and bottom Flush Bolt (inactive leaf)

P. Hardware Set No. 15: Exterior Stores Door.

1-1/2 pair Butts - Stanley FBB-191.
1 Temporary Core as specified.
1 Cylinder Housing – Medeco Keymark 33K076048, Corbin/Russwin Master Ring Collar 255F54 and Backplate 135F10-8.
1 Panic Exit Device – Von Duprin 99L w/ outside lever trim
1 Automatic Closer - LCN 4110 Series.
1 Kick Plate - 18 ga. stainless steel w/ stainless steel fasteners.

1 set Weatherstripping - Pemko 309DP-PG jamb / top, 309DP-DB bottom, 346D rain drip.
1 8" wide Threshold - Pemko 2548A.
1 Electric Strike – Stainless Steel, non-handed, Fail Secure.

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.

1.2 DEFINITIONS:

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.3 PERFORMANCE REQUIREMENTS:

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

   a. Structural Performance: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour (meters per second) at 33 feet above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Plans.

      1) Fire/Windstorm Classification: Class 1A-105.
      2) Hail-Resistance Rating: MH.
      3) Approval Category for Wind Zone: HM-SM (hurricane-prone region with small debris impact).
      4) Design Loads: Refer to Structural Drawings.

   b. Minimum Glass Thickness for Exterior Lites: Not less than 1/4 inch thick.
   c. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 1/4 inch thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:

   a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.

      1) Maximum U-Factor Required: 0.38.

b. Solar Heat Gain Coefficient: NFRC 200.
c. Solar Optical Properties: NFRC 300.

1.4 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each glass product and glazing material indicated.

C. Samples: For the following products, in the form of 12-inch square Samples for glass and of 12-inch long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: Use same designations indicated on plans for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

E. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.
3. Qualification Data: For installers.
4. Product Test Reports: For each of the following types of glazing products:

a. Tinted float glass.
b. Insulating glass.
c. Glazing sealants.
d. Glazing gaskets.

F. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE:

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs

glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, coated float glass, laminated glass glass-clad polycarbonate and insulating glass.

C. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.

D. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

E. Glass Product Testing: Obtain glass test results for product test reports in Part 1.4, "Submittals" from a qualified testing agency based on testing glass products.

1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

F. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in Part 1.4, "Submittals" from a qualified testing agency based on testing current sealant formulations within a 36-month period.

1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

G. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
2. Submit not fewer than four pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.

5. Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.

H. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

I. Glazing for Fire-Rated Window Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.

J. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency or manufacturer acceptable to authorities having jurisdiction.
2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

K. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

L. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:

1. Insulating Glass Certification Council.
2. Associated Laboratories, Inc.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.7 PROJECT CONDITIONS:

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.8 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in Part 1.2, "Definitions", f.o.b. the nearest shipping point to Project Site, within specified warranty period indicated below.

1. Warranty Period: 10 years from the issuance of the Certificate of Compliance.

C. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in Part 1.2, "Definitions", f.o.b. the nearest shipping point to Project Site, within specified warranty period indicated below.

1. Warranty Period: 10 years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. In other portions of Part 2 where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AGC Glass Company.
b. Pilkington Building Products North America.
c. Vitro Architectural Glass.

2.2 GLASS PRODUCTS:

A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.

1. Ultra-Clear (Low-Iron) Float Glass: Class I (clear); with a minimum 91 percent visible light transmission and a minimum solar heat gain coefficient of 0.87.

a. Available Products:

1) AGC Glass Company; Krystal Klear.
2) Pilkington Building Products North America; Optiwhite.
3) PPG Industries, Inc.; Starphire.

B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1.3 "Performance Requirements".
3. For uncoated glass, comply with requirements for Condition A.
4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).

C. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for

Class CBA units and with requirements specified herein and in Part 2.11, "Insulating-Glass Units".

1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1.3 "Performance Requirements".
2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
4. Sealing System: Dual seal, with primary and secondary sealants as follows:

    a. Manufacturer's standard sealants.

5. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.3 FIRE RESISTANCE RATED GLAZING PRODUCTS:

A. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing according to ASTM E 119 or UL 263.

B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, that the glazing is approved for use in walls, and the fire-resistance rating in minutes.

C. Double Glazing Units with Clear Gel Fill: Double glazing units made from two lites of uncoated, fully tempered, ultraclear float glass; with a perimeter edge seal enclosing a cavity filled with optically clear, intumescent gel; and complying with 16 CFR 1201, Category II.

2.4 GLAZING GASKETS:

A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:

1. Neoprene, ASTM C 864.
2. EPDM, ASTM C 864.
3. Silicone, ASTM C 1115.
4. Thermoplastic polyolefin rubber, ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:

1. Neoprene.
2. EPDM.
3. Silicone.
4. Thermoplastic polyolefin rubber.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.5 GLAZING SEALANTS:

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Designer from manufacturer's full range.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Single-Component Neutral- and Basic-Curing Silicone Glazing Sealants GS:

a. Available Products:

1) Dow Corning Corporation; 790.
2) GE Silicones; SilPruf LM SCS2700.
3) Tremco; Spectrem 1 (Basic).
4) GE Silicones; SilPruf SCS2000.
5) Pecora Corporation; 864.
6) Pecora Corporation; 890.
7) Polymeric Systems Inc.; PSI-641.
8) Sonneborn, Div. of ChemRex, Inc.; Omniseal.
9) Tremco; Spectrem 3.

b. Type and Grade: S (single component) and NS (nonsag).
c. Class: 50.
d. Use Related to Exposure: NT (nontraffic).
e. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.

1) Use O Glazing Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating.

C. Glazing Sealants for Fire-Resistive Glazing Products: Identical to products used in test assemblies to obtain fire-protection rating.

2.6 GLAZING TAPES:

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

1. Type 1, for glazing applications in which tape acts as the primary sealant.
2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS:

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.8 FABRICATION OF GLAZING UNITS:

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

C. Grind smooth and polish exposed glass edges and corners.

2.9 MONOLITHIC FLOAT-GLASS UNITS:

A. Uncoated Clear Float-Glass Units MG-1: Class 1 (clear) Kind FT (fully tempered) float glass.

1. Thickness: 1/4 inch.
2. Self-Cleaning, Low-Maintenance Coating: Pyrolytic coating on first surface.

B. Uncoated Tinted Float-Glass Units MG-2: Class 2 (tinted) Kind HS (heat-strengthened) float glass.

1. Thickness: 1/4 inch.
2. Tint Color: Green.

2.10 INSULATING-GLASS UNITS

A. Passive Solar Low-E Insulating-Glass Units IG:

1. Overall Unit Thickness and Thickness of Each Lite: 1 inch (25 mm) and 6.0 mm.

2. Interspace Content: Argon.
3. Outdoor Lite: Class 2 (tinted) float glass.

    a. Tint Color: Green.
    b. Kind HS (heat strengthened).
    c. Self-Cleaning, Low-Maintenance Coating: Pyrolytic coating on first surface.

4. Indoor Lite: Class 1 (clear) ultra-clear (low-iron) float glass.

    a. Kind HS (heat strengthened).

5. Low-E Coating or Film: Pyrolytic or sputtered on second or third surface or low-e-coated film suspended in the interspace.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine framing glazing, with Installer present, for compliance with the following:

    1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
    2. Presence and functioning of weep system.
    3. Minimum required face or edge clearances.
    4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL:

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Plans, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project Site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING:

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY):

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET):

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING:

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.8 CLEANING AND PROTECTION:

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of issuance of the Certificate of Compliance. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 089000 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Drainable Combination, extruded-aluminum louvers.

B. Related CSI Sections:

1. Division 04 Section 042000, "Unit Masonry" for building wall vents (brick vents) into masonry.

1.2 DEFINITIONS:

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.

C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.3 PERFORMANCE REQUIREMENTS:

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on a uniform pressure of 20 lbf/sq. ft., acting inward or outward.

B. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. Design earthquake spectral response acceleration, short period (0.2 seconds)(Sds) for Project is 0.1776.
2. Design earthquake spectral response acceleration at 1.0 second periods S_{D1}: 0.68.
3. Component Importance Factor is 1.5.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.4 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

C. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

D. Samples for Initial Selection: For units with factory-applied color finishes. Match color of aluminum windows.

1.5 QUALITY ASSURANCE:

A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.6 PROJECT CONDITIONS:

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.

D. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL:

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
2. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.

F. Provide extended sills for recessed louvers.

G. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 DRAINABLE COMBINATION, EXTRUDED-ALUMINUM LOUVERS:

A. Louver Construction and Operation: Provide adjustable louvers with extruded-aluminum frames and blades not less than 0.080-inch nominal thickness, and with operating mechanisms to suit louver sizes.

1. Motor operation with 2-position, spring-return application (with power on, motor opens louver; with power off, spring closes louver); equipped with terminals for controlling devices.

B. Dual-Blade, Drainable-Blade, Adjustable Louver: Fixed drainable blades and adjustable plain blades combined in single frame.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. ELC6375DAX as manufactured by Ruskin Company; Tomkins PLC, or an approved equal.
2. Louver Depth: 6 inches, overall.
3. Louver Performance Ratings:

a. Size: As noted on Architectural plans.
b. Total Free Area: As noted on Mechanical plans.
c. Point of Beginning Water Penetration: Not less than 1000 fpm.
d. Air Performance: Not more than 0.15-inch wg static pressure drop at 1000-fpm free-area intake velocity.

4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS:

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screen Location for Adjustable Louvers: Interior face unless otherwise indicated.
3. Screening Type: Bird screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch square mesh min., 0.040-inch wire min..

2.5 FINISHES, GENERAL:

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.6 ALUMINUM FINISHES:

A. Finish louvers after assembly.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: Dark bronze.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project Site.

3.3 INSTALLATION:

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with CSI Division 07 Section 079200, "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes non-load-bearing steel framing members for the following applications:

1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).

B. Related CSI Sections include the following:

1. Division 09 Section 092900, "Gypsum Board".
2. Division 09 Section 093000, “Tiling”.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE:

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL:

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.

2. Protective Coating: ASTM A 653/A 653M, G40 (Z120) or Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS:

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch diameter wire, or double strand of 0.0475-inch diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.

C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch wide flanges.

D. Depth: 2-1/2 inches. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation; 660-C Drywall Furring System.
c. USG Corporation; Drywall Suspension System.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES:

A. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.0312 inch.
2. Depth:

a. 3-5/8 inches.
b. 5-5/8 inches.

B. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0312 inch.

2.4 AUXILIARY MATERIALS:

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide the following:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL:

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS:

A. Install suspension system components in sizes and spacings indicated on plans, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.

D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLING FRAMED ASSEMBLIES:

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

1. Space studs as follows:

a. Single-Layer Application: 16 inches o.c., unless otherwise indicated.
b. Tile backing panels: 16 inches o.c., unless otherwise indicated.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

D. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Ceramic tile.
2. Cementitious Backer Units.

B. Related Sections:

1. Division 07 CSI Section 079200, "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.2 DEFINITIONS:

A. Module Size: Actual tile size plus joint width indicated.

B. Face Size: Actual tile size, excluding spacer lugs.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

D. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.4 QUALITY ASSURANCE:

A. Source Limitations for Tile: Obtain all tile from one source or producer in accordance with Form 818 Article 1.20-1.06.01.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:

1. Waterproofing
2. Joint sealants.
3. Cementitious backer units.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.6 PROJECT CONDITIONS:

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.7 SPARE PARTS:

A. Furnish to the Engineer spare parts that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL:

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.2 TILE PRODUCTS:

A. Tile Type CT-1: Factory-mounted glazed ceramic mosaic tile.

1. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Olean; Division of Dal-Tile International Inc.
b. Crossville, Inc.
c. Daltile; Division of Dal-Tile International Inc.

2. Face Size: 4 by 4 inches.
3. Thickness: 5/16 inch.
4. Finish: Bright, opaque glaze.
5. Tile Color: As selected by Designer from manufacturer's full range (earth tones).

2.3 TILE BACKING PANELS:

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, in maximum lengths available to minimize end-to-end butt joints.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Custom Building Products; Wonderboard.

b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
c. USG Corporation; DUROCK Cement Board.

2. Thickness: 1/2 inch.
3. Joint Compound for Tile Backing Panels:

a. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.4 GROUT MATERIALS:

A. Standard Cement Grout: ANSI A118.6.

1. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Custom Building Products.
b. Laticrete International, Inc.
c. Southern Grouts & Mortars, Inc.
d. .

2. Grout Color: As selected by Designer from manufacturer's full range (earth tones).

2.5 ELASTOMERIC SEALANTS:

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in CSI Division 07 Section 079200, "Joint Sealants."

1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. DAP Inc.; 100 percent Silicone Kitchen and Bath Sealant.

b. Dow Corning Corporation; Dow Corning 786.
c. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
d. Laticrete International, Inc.; Latasil Tile & Stone Sealant.
e. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
f. Tremco Incorporated; Tremsil 600 White.

2.6 MISCELLANEOUS MATERIALS:

A. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

B. Grout Sealer: Grout manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.

2.7 MIXING MORTARS AND GROUT:

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project Site before installing.

3.3 TILE INSTALLATION:

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

C. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

D. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Glazed Wall Tile: 1/8 inch.

E. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

3.4 TILE BACKING PANEL INSTALLATION:

A. Install cementitious backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 CLEANING AND PROTECTING:

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove epoxy and latex-portland cement grout residue from tile as soon as possible.

2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

END OF SECTION 093000

SECTION 094020 - POLYACRYLATE MODIFIED TERRAZZO

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Polyacrylate Modified Terrazzo
2. Precast Terrazzo Base

1.2 PREINSTALLATION MEETINGS:

A. Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 818 Article 1.20-1.05.24 subsection 2.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of terrazzo and accessory indicated.

C. Shop Drawings: Include terrazzo fabrication and installation requirements. Include plans, elevations, sections, component details, and attachments to other Work. Show layout of the following:

1. Divider strips.
2. Expansion joint strips.

D. Product Samples: For each type, color, and pattern of terrazzo and accessory required and in size indicated below:

1. Terrazzo: 6-inch square Samples.
2. Base: 6-inch long by 8-inch tall straight wall base sample.
3. Accessories: 6-inch long Samples of each exposed strip item required.

E. Quality Assurance Submittals

1. Qualification Data: For Installer.
2. Material test reports or certificates.

F. Maintenance Data. For terrazzo include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – OPERATION AND MAINTENANCE MANUALS.

1.4 QUALITY ASSURANCE:

A. Installer Qualifications: A qualified installer (applicator) who is acceptable to terrazzo manufacturer to install manufacturer's products.

1. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.

B. NTMA Standard: Comply with NTMA Guide Specification and written recommendations for terrazzo type indicated, unless more stringent requirements are specified.

1.5 PERFORMANCE REQUIREMENTS:

A. Weight: 4.5 psf in a thickness of 3/8 inch.

B. Impact: The Polyacrylate terrazzo shall, when bonded securely to concrete, show no visible signs of chipping, cracking, or loss of bond when tested with 16 foot pounds.

C. Moisture Absorption: The Polyacrylate terrazzo shall not absorb more than 5% moisture based on its weight at normal atmospheric conditions when tested in accordance with MIL-D-3134F, Section 4.7.8.

D. Resistance to Wear: The Polyacrylate terrazzo shall show wear not to exceed 0.150 inch when tested in accordance with MIL-D-3134F, Section 4.7.10.

E. Floor shall be slip resistant.

F. Floor shall be non-toxic and non-allergenic.

1.6 PROJECT CONDITIONS:

A. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.

PART 2 - PRODUCTS

2.1 POLYACRYLATE MODIFIED TERRAZZO:

A. Available Products: Subject to compliance with Project requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. General Polymers Corporation; Terrazzo
2. Selby-Ucrete Flooring Group of HSC
3. Harris Specialty Chemicals, Inc.

B. Topping Thickness: 3/8 inch.

C. Materials: Comply with NTMA "Guide Specification for Polyacrylate Modified Terrazzo" unless more stringent requirements are indicated.

1. Primer: Product of manufacturer recommended for substrate and use indicated.
2. Portland Cement: ASTM C 150, Type 1.

3. Marble Chips: Complying NTMA standards and of type and in gradation required for mix, with Ha 10 minimum abrasive -hardness value when tested according to ASTM C241, 0.75 percent maximum 24-hour absorption rate, dust content of less than 1 percent by weight, and containing no deleterious or foreign matter..

4. Finishing Grout: Resin based.
5. Seal Coat: Slip resistant, thin-coat terrazzo sealer of or approved by terrazzo manufacturer.

D. Mix: Comply with NTMA "Guide Specification for Polyacrylate Modified Terrazzo" and manufacturer's written instructions for component proportions and mixing.

1. Color and Pattern: NTMA Template C2-30.

2.2 ACCESSORIES

A. Thin-Set Divider Strips: Angle or T type, 3/8 inch deep.

1. Material: White zinc alloy.
2. Top Width: 1/4 inch

B. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material, thickness, and color of divider strips and in depth required for topping thickness indicated.

C. Accessory Strips: Match divider-strip width, material, and color, unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:

1. Base bead and base dividers.
2. Nosings for stair treads and landings.
3. Edge beads for exposed edges of terrazzo.

D. Patching and Fill Material: Resinous product of or approved by terrazzo manufacturer and recommended by manufacturer for application indicated.

E. Abrasive Strips: Silicon carbide or aluminum oxide in epoxy-resin binder set in channel, 1/2 inch wide by depth required by terrazzo thickness and matching divider-strip material.

F. Joint Sealants: Recommended by terrazzo and sealant manufacturers and complying with requirements in CSI Division 07 Section 079200, "Joint Sealants."

G. Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.

2.3 PRECAST EPOXY TERRAZZO:

A. Available Manufacturers: Subject to compliance with Project requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Romoco Precast Terrazzo Products.

B. Precast Epoxy Terrazzo Base Units: 1/4 inch thick, 8 inches tall; cast in maximum lengths possible, but not less than 36 inches; with rounded, finished top edge.

1. Type: Straight wall base.
2. Outside Corner Units: 45 degree miter the corners to provide a smooth transition at the corners.
3. Color, Pattern and Finish: Match adjacent poured-in-place flooring.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 INSTALLATION, GENERAL:

A. Preparation:

1. Clean substrates of substances that might impair terrazzo bond, including oil, grease, and curing compounds to produce clean, dry, and neutral substrate for terrazzo application. Determine dryness characteristics by performing moisture tests recommended by terrazzo manufacturer.

2. Concrete: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with epoxy terrazzo.

   a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
   b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.

3. Concrete Masonry Units: Fill voids and chipped areas with mortar mix to produce smooth, plumb surface.

B. Dust Control: Protect other work from dust generated by grinding operations. Control dust to prevent air pollution and comply with environmental protection regulations.

   1. Erect and maintain temporary enclosures and other suitable methods to limit dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

C. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA "Guide Specification for Polyacrylate Modified Terrazzo."

D. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.

E. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.

F. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.

G. Divider and Accessory Strips: Install in adhesive setting bed without voids below strips.

   1. Divider and Control-Joint Strips: Install back to back directly above substrate control joints.

      a. Install with 1/4-inch gap between strips and install sealant in gap.

3.3 POURED-IN-PLACE TERRAZZO INSTALLATION:

1. Place terrazzo mixture in panels formed by divider strips and trowel mixture to top of strips.
2. Seeding of additional marble chips is optional.
3. Roll and compact surface until all excess cement and water has been extracted.
4. Trowel to a dense uniform flat surface disclosing lines of divider strips.

B. Curing: Contractor shall cure the terrazzo topping as follows:

1. After completing placement of terrazzo and composition has sufficiently set, cover with water or polyethylene sheeting.
2. Cure until topping develops sufficient strength to prevent lifting or pulling of terrazzo chips during grinding.

C. Repair: Remove and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA written recommendations, as approved by Designer.

D. Construction Tolerances: Limit variation in terrazzo surface from level to 1/ 4 inch in 10 feet.

E. Cleaning:

1. Remove grinding dust from installation and adjacent areas.
2. Wash terrazzo surfaces with cleaner; rinse surfaces with water and allow to dry thoroughly.

F. Seal surfaces according to NTMA written recommendations. Apply sealer according to sealer manufacturer's written instructions.

3.4 PRECAST EPOXY TERRAZZO INSTALLATION:

A. Set units using method recommended by NTMA and manufacturer, unless otherwise indicated. Set units with alignment level and true to dimensions, varying 1/8 inch maximum in length, height, or width.

1. Base: Back-butter for full contact with substrate.

B. Seal joints between units with joint sealants.

END OF SECTION 094020

SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes acoustical tiles for ceilings.

1.2 DEFINITIONS:

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light-Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Tile: Set of full-size Samples of each type, color, pattern, and texture.

D. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.4 QUALITY ASSURANCE:

A. Source Limitations: Obtain each type of acoustical ceiling tile and supporting suspension system through one source from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Fire-Test-Response Characteristics: Provide acoustical tile ceilings that comply with the following requirements:

1. Surface-Burning Characteristics: Provide acoustical tiles with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

C. Seismic Standard: Provide acoustical tile ceilings designed and installed to withstand the effects of earthquake motions according to the following:

1. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Deliver acoustical tiles, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS:

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION:

A. Coordinate layout and installation of acoustical tiles and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, and partition assemblies.

1.8 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size tiles equal to 2% of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL TILES, GENERAL:

A. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

B. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical tiles are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Designer from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.2 MOISTURE RESISTANT ACOUSTICAL TILES:

A. Basis-of-Design Product: Subject to compliance with requirements, provide CLEAN ROOM ClimaPlus Class 10M-100M as manufactured by USG Interiors Inc.; or an approved equal.

B. Classification: Provide tiles complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type X, Form 1
2. Pattern: CGI (smooth).

C. Color: White.

D. LR: Not less than .79.

E. NRC: Not less than 0.60.

F. CAC: Not less than 35.

G. AC: Not less than 180.

H. Edge/Joint Detail: Square.

I. Thickness: 5/8 inch.

J. Modular Size: 24” x 24”.

K. Where Used: Women’s Room, Men’s Room, Men’s Locker, and Janitor’s.

2.3 ACOUSTICAL TILES:

A. Basis-of-Design Product: Subject to compliance with requirements, provide Glacier #707 as manufactured by USG Interior Inc., or an approved equal.

B. Classification: Provide tiles complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type III, Form 4
2. Pattern: F (heavily textured).

C. Color: White.

D. LR: Not less than 0.65.

E. NRC: Not less than 0.70.

F. CAC: Not less than 35.

G. AC: Not less than 170.

H. Edge/Joint Detail: Shadowline.

I. Thickness: 3/4 inch.

J. Modular Size: 24” x 24”.

K. Where Used: All applicable rooms, Excluding: Women’s Room, Men’s Room, Men’s Locker, and Janitor’s.

2.4 METAL SUSPENSION SYSTEMS, GENERAL:

A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated (Women’s Room, Men’s Room, Men’s Locker, and Janitor’s).

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
3. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch diameter wire.

E. Hanger Rods, Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch diameter bolts.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate lateral forces.

H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical tiles in-place.

2.5 METAL SUSPENSION SYSTEM FOR MOISTURE RESISTANT ACOUSTICAL TILES:

A. Basis-of-Design Product: Subject to compliance with requirements, provide Model DONN ZXLA as manufactured by USG Interiors, Inc., or an approved equal.

B. Wide-Face, Capped, Double-Web, Fire-Rated Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 15/16-inch wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
4. Cap Material: Aluminum cold-rolled sheet.
5. Cap Finish: Painted white.

C. Where Used: Women’s Room, Men’s Room, Men’s Locker, and Janitor’s.

2.6 METAL SUSPENSION SYSTEM FOR ACOUSTICAL TILES:

A. Basis-of-Design Product: Subject to compliance with requirements, provide Model DONN DX/DXL as manufactured by USG Interiors, Inc., or an approved equal.

B. Wide-Face, Capped, Double-Web, Fire-Rated Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 15/16-inchwide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
4. Cap Material: Aluminum cold-rolled sheet.
5. Cap Finish: Painted white.

C. Where Used: All applicable rooms, Excluding: Women's Room, Men's Room, Men's Locker, and Janitor's.

2.7 METAL EDGE MOLDINGS AND TRIM:

A. Basis-of-Design Product: Subject to compliance with requirements, provide as manufactured by USC Interior, Inc. or an approved equal.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical tile edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.8 ACOUSTICAL SEALANT:

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Acoustical Sealant for Concealed Joints:

a. OSI Sealants, Inc.; Pro-Series SC-175 Rubber Base Sound Sealant.
b. Pecora Corporation; BA-98.
c. Tremco, Inc.; Tremco Acoustical Sealant.

B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical tile ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION:

A. General: Install acoustical tile ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to

inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
7. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
8. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical tiles.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Arrange directionally patterned acoustical tiles as follows:

1. Install tiles with pattern running in one direction parallel to long or short axis of space.

F. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.

3.4 CLEANING:

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095123

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

D. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples.

1.3 SPARE PARTS:

A. Furnish spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet (3 linear m) of each type, color, pattern, and size of resilient product installed.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.5 FIELD CONDITIONS:

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than [95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until the issuance of the Certificate of Compliance, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. FloorScore Compliance: Resilient base shall comply with requirements of FloorScore certification.

2.2 VINYL BASE:

A. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Armstrong World Industries, Inc.
2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
3. Johnsonite; A Tarkett Company.
4. Roppe Corporation, USA.

B. Product Standard: ASTM F 1861, Type TV vinyl.

1. Group: solid, homogeneous.
2. Style:
   a. Style: Cove.

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Cut lengths 48 inches (1219 mm) long.

F. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 RUBBER MOLDING ACCESSORY:

A. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Roppe Corporation, USA.
2. VPI, LLC, Floor Products Division.

B. Description: Rubber transition strips.

C. Profile and Dimensions: As required.

D. Colors and Patterns: As selected by Designer from full range of industry colors.

2.4 INSTALLATION MATERIALS:

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION:

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION:

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

3.4 CLEANING AND PROTECTION:

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes before applying liquid floor polish.

1. Apply two coat(s).

E. Cover resilient products subject to wear and foot traffic until the issuance of the Certificate of Compliance.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Rubber floor tile.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 816, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Samples: Provide units of each color and pattern of floor tile from manufacturer's full range.

D. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

E. Qualification Data: For Installer.

F. Maintenance Data: For each type of floor tile to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.3 SPARE PARTS:

A. Furnish to the Engineer spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box of each type, color, and pattern of floor tile installed.

1.4 QUALITY ASSURANCE:

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.6 FIELD CONDITIONS:

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until the issuance of the Certificate of Compliance, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install floor tile after other finishing operations, including painting, have been completed.

D. Close spaces to traffic during floor tile installation.

E. Close spaces to traffic for 48 hours after floor tile installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. FloorScore Compliance: Resilient tile flooring shall comply with requirements of FloorScore certification.

2.2 RUBBER FLOOR TILE:

A. Basis-of-Design Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1. Nora Rubber Flooring, Freudenberg Building Systems, Inc

B. Tile Standard: ASTM F 1344, Class I-A, homogeneous rubber tile, solid color.

C. Hardness: Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D 2240.

D. Wearing Surface: Molded pattern.

1. Molded-Pattern Figure: Raised discs or Raised squares.

E. Thickness: 0.125 inch.

F. Size: 24 by 24 inches.

G. Colors and Patterns: As selected by Designer from full range of manufacturer colors.

2.3 INSTALLATION MATERIALS:

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

1. Adhesives shall comply with the following limits for VOC content:

a. Rubber Floor Adhesives: 60 g/L or less.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

D. Moisture Mitigation: Two-component, high solids, moisture tolerant, high density, low odor, epoxy-based product produced by resilient tile flooring manufacturer specifically recommended to reduce alkalinity levels and moisture emission to acceptable levels.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

F. Contractor shall provide a moisture mitigation material according to instructions and recommendations of moisture mitigation material manufacturer.

3.3 FLOOR TILE INSTALLATION:

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction.

D. Moisture Mitigation: Apply to slab according to manufacturer’s written instructions.

E. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

F. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

H. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

I. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION:

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply two coat(s).

E. Cover floor tile until the issuance of the Certificate of Compliance.

END OF SECTION 096519

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Steel Substrates.
2. Door and Door Frames.
3. Existing Steel.

B. Related CSI Sections include the following:

1. Division 09 Section 099123, "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on plans and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 QUALITY ASSURANCE:

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Deliver all painting materials in sealed, original labeled containers bearing manufacturer's name, brand name, type of paint or coating and color designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

C. Where toxic and/or volatile / explosive / flammable materials are being used, provide adequate fireproof storage lockers and take all necessary precautions and post adequate warnings (e.g. no smoking) as required.

D. Take all necessary precautionary and safety measures to prevent fire hazards and spontaneous combustion and to protect the environment from hazard spills. Materials that constitute a fire hazard (paints, solvents, drop clothes, etc.) shall be stored in suitable closed and rated containers and removed from the site on a daily basis.

1.5 PROJECT CONDITIONS:

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Benjamin Moore & Co.

2. ICI Paints.
3. Pittsburgh Paints.
4. Sherwin-Williams Company (The).

B. Basis of Design Color Selections (where known):

1. Exterior Steel, Existing Steel, Doors and Frames: Dark Brown, Bronzetone #C16360 as manufactured by Pittsburgh Paints, or an approved equal.

2.2 PAINT, GENERAL:

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected by Designer from manufacturer's full range.

2.3 METAL PRIMERS:

A. Alkyd Anticorrosive Metal Primer: MPI #19.

1. VOC Content: E Range of E3.

B. Alkyd Anticorrosive Metal Primer: MPI #79.

1. VOC Content: E Range of E2.

C. Quick-Drying Alkyd Metal Primer: MPI #76.

1. VOC Content: E Range of E3.

2.4 EXTERIOR ACRYLIC PAINTS:

A. Exterior Acrylic (Gloss): MPI #114 (Gloss Level 6).

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 1.

2.5 EXTERIOR ALKYD PAINTS:

A. Exterior Quick Dry Alkyd (Gloss): MPI #96 (Gloss Level 7).

1. VOC Content: E Range of E3.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION:

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

F. C.M.U. Substrates: Remove dirt and loose paint. Clean using methods recommended in writing by paint manufacturer.

3.3 APPLICATION:

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL:

A. Contractor shall touch up and restore painted surfaces damaged during construction.

3.5 CLEANING AND PROTECTION:

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project Site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Engineer, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE:

A. Steel and Existing Steel Substrates:

1. Structural Steel:

a. Prime Coat: Zinc rich organic primer. (MPI#18)
b. Intermediate Coat: Exterior acrylic to match topcoat.
c. Topcoat: Exterior acrylic, gloss. (MPI#114)
d. Door Stencils: Intermediate and Topcoat: Exterior acrylic to match topcoat.

B. Doors and Door Frames:

1. Quick-Drying Enamel System: MPI EXT 5.1A.

a. Prime Coat: Primer, alkyd, quick dry, for metal.
b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
c. Topcoat: Alkyd, quick drying, gloss.
d. Door Stencils: Intermediate and Topcoat: Alkyd to match topcoat.

C. Galvanized-Metal Substrates:

1. Latex over Waterbourne Primer System:

a. Prime Coat: Galvanized primer, water based. (MPI#134)
b. Intermediate Coat: Exterior acrylic to match topcoat.
c. Topcoat: Exterior acrylic, gloss. (MPI#114)

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete slab.
2. Concrete masonry units (CMU).
3. Existing Concrete masonry units (CMU).
4. Steel.
5. Existing Steel.
6. Gypsum board.
7. Wood.

B. Related CSI Sections include the following:

1. Division 05 Section 051200, “Structural Steel Framing” for shop primer information on structural steel members.
2. Division 05 Section 052100, “Steel Joist Framing” for shop primer information on steel joists.
3. Division 09 Section 099113, "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 QUALITY ASSURANCE:

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Deliver all painting materials in sealed, original labeled containers bearing manufacturer's name, brand name, type of paint or coating and color designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

C. Where toxic and/or volatile / explosive / flammable materials are being used, provide adequate fireproof storage lockers and take all necessary precautions and post adequate warnings (e.g. no smoking) as required.

D. Take all necessary precautionary and safety measures to prevent fire hazards and spontaneous combustion and to protect the environment from hazard spills. Materials that constitute a fire hazard (paints, solvents, drop clothes, etc.) shall be stored in suitable closed and rated containers and removed from the site on a daily basis.

1.5 PROJECT CONDITIONS:

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Perform no interior painting or decorating work unless adequate continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above minimum requirements for 24 hours before, during and after paint

application. Provide supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

D. Conduct all moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple cover patch test.

E. Test masonry surfaces for alkalinity as required.

1. Masonry surfaces must be installed at least 28 days prior to painting and decorating work and must be visually dry on both sides.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Benjamin Moore & Co.
2. ICI Paints.
3. Pittsburgh Paints.
4. Sherwin-Williams Company (The).

B. Basis of Design Color Selections (where known):

1. Interior Steel, Existing Steel, Doors and Frames: Dark Brown, Bronzetone #C16360 as manufactured by Pittsburgh Paints, or an approved equal.
2. Interior CMU, Existing CMU and Gypsum Board Walls: Off White, SPEEDHIDE product line as manufactured by Pittsburgh Paints, or an approved equal.
3. Interior CMU, Existing CMU and Gypsum Board Wall Sealer: SEAL GRIP product line as manufactured by Pittsburgh Paints, or an approved equal.
4. Interior CMU and Existing CMU Block Filler: SPEEDHIDE product line as manufactured by Pittsburgh Paints, or an approved equal.
5. Fire Suppression Piping: Red, Gypsy Red #SW 6865 as manufactured by Sherwin-Williams, or an approved equal.

2.2 PAINT, GENERAL:

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
4. Restricted Components: Paints and coatings shall not contain any of the following:

    a. Acrolein.
    b. Acrylonitrile.
    c. Antimony.
    d. Benzene.
    e. Butyl benzyl phthalate.
    f. Cadmium.
    g. Di (2-ethylhexyl) phthalate.
    h. Di-n-butyl phthalate.
    i. Di-n-octyl phthalate.
    j. 1,2-dichlorobenzene.
    k. Diethyl phthalate.
    l. Dimethyl phthalate.
    m. Ethylbenzene.
    n. Formaldehyde.
    o. Hexavalent chromium.
    p. Isophorone.
    q. Lead.
    r. Mercury.
    s. Methyl ethyl ketone.
    t. Methyl isobutyl ketone.
    u. Methylene chloride.
    v. Naphthalene.
    w. Toluene (methylbenzene).
    x. 1,1,1-trichloroethane.
    y. Vinyl chloride.

C. Colors: As selected by Designer from manufacturer's full range.

2.3 BLOCK FILLERS:

A. Interior/Exterior Latex Block Filler: MPI #4.

1. VOC Content: E Range of E3.

2.4 COATINGS:

A. Solvent Based Epoxy Coating (Gloss): MPI #77.

1. VOC Content: E Range of E3.

B. Light Industrial Water Based Coating (Gloss): MPI #154 (Gloss Level 6).

1. VOC Content: E Range of E3.

2.5 PRIMERS/SEALERS:

A. Interior Latex Primer/Sealer: MPI #50.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 1.

B. Interior Alkyd Primer/Sealer: MPI #45.

1. VOC Content: E Range of E2.

2.6 METAL PRIMERS:

A. Acrylic Anticorrosive Metal Primer: MPI #19.

1. VOC Content: E Range of E3.

B. Alkyd Primer: MPI #275.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 1.

C. Galvanized Water Based Primer: MPI#134.

1. VOC Content: E Range of E3.

D. Rust-Inhibitive Water Based Primer: MPI #107.

1. VOC Content: E Range of E3.

2.7 WOOD PRIMERS:

A. Interior Latex-Based Wood Primer: MPI #39.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 1.

2.8 LATEX PAINTS:

A. Interior Latex: MPI #44 (Gloss Level 2).

1. VOC Content: E Range of E3.

B. Interior Latex (Semi-Gloss): MPI #54 (Gloss Level 5).

1. VOC Content: E Range of E3.

2.9 ACRYLIC PAINTS:

A. Interior Acrylic (Gloss): MPI #114 (Gloss Level 6).

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 1.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. 12 % for masonry.
2. 15% for wood.
3. 12 % for gypsum board.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION:

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

G. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

H. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION:

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms, bay areas, and occupied spaces including, but not limited to, the following:

1. Mechanical Work:

a. Uninsulated metal piping. Paint piping on wall similar to scheduled finish color on adjacent wall. Paint piping near roof joists similar to scheduled finish color on adjacent roof joists.
b. Fire suppression piping.

2. Electrical Work:

a. Electrical conduit, exposed. Paint conduit on adjacent wall similar to scheduled finish color on wall. Terminate paint at ceiling.

F. Painting Structural Steel: Columns, beams, girders, girts, sub-girts, cross bracing and open web joists.

3.4 FIELD QUALITY CONTROL:

A. Contractor shall touch up and restore painted surfaces damaged during construction.

3.5 CLEANING AND PROTECTION:

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project Site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Engineer, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE:

A. Concrete Slab:

1. Epoxy System:

a. Prime Coat: Epoxy, to match topcoat.
b. Intermediate Coat: Epoxy, to match topcoat.
c. Topcoat: Epoxy, gloss. (MPI#77)

B. CMU and Existing CMU Substrates:

1. Latex System:

a. Block Filler: Block filler, latex, interior. (MPI#4)
b. Intermediate Coat: Interior latex to match topcoat.
c. Topcoat: Latex, interior, semi-gloss. (MPI#54)

C. Steel and Existing Steel Substrates:

1. Structural Steel and Steel Joists:

a. Prime Coat: Zinc rich organic primer. (MPI#18)
b. Intermediate Coat: Interior acrylic to match topcoat.
c. Topcoat: Interior acrylic, gloss. (MPI#114)

2. Steel Doors and Frames, and Steel Window:

a. Primer Coat: Galvanized water based primer. (MPI#134)
b. Intermediate Coat: Interior acrylic to match topcoat.
c. Topcoat: Interior acrylic, gloss. (MPI#114)

3. Steel Piping:

a. Primer Coat: Rust-inhibitive water based primer. (MPI#107)
b. Intermediate Coat: Interior light industrial coating to match topcoat.
c. Topcoat: Interior light industrial coating, gloss. (MPI#154)

D. Galvanized-Metal Substrates:

1. Latex over Waterbourne Primer System:

a. Prime Coat: Galvanized primer, water based. (MPI#134)
b. Intermediate Coat: Interior latex to match topcoat.
c. Topcoat: Latex, interior, semigloss. (MPI#54)

E. Gypsum Board Substrates:

1. Latex System:

a. Prime Coat: Primer sealer, latex, interior. (MPI#50)
b. Intermediate Coat: Latex, interior to match topcoat.
c. Topcoat: Latex, interior, semigloss. (MPI#54)

F. Wood Substrates:

1. Latex System:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.
b. Intermediate Coat: Latex, interior to match topcoat.
c. Topcoat: Latex, interior, (Gloss Level 2), MPI #44.

END OF SECTION 099123

SECTION 101100 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 SUMMARY

1. Section Includes: Tackboards.

1.2 DEFINITIONS:

A. Tackboard: Framed, tackable surface.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and textures available.

D. Quality Assurance Submittals:

1. Letter from the Manufacturer for each composite wood product used stating that the bonding agent contains no urea formaldehyde.

1.4 QUALITY ASSURANCE:

A. Source Limitations: Obtain visual display surfaces from single source from single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL:

A. Vinyl Fabric: Mildew resistant, washable, complying with FS CCC-W-408D, Type II, burlap weave; weighing not less than 13 oz./sq. yd.; with surface-burning characteristics indicated.

B. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.

C. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.

2.2 TACKBOARD ASSEMBLIES:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. A-1 Visual Systems.
2. AARCO, Inc.
3. Best-Rite Manufacturing.

B. Vinyl-Fabric-Faced Tackboard: 1/4-inch thick, vinyl-fabric-faced cork sheet factory laminated to 1/4-inch thick particleboard backing.

1. Color: As selected from manufacturer's full range of colors.
2. Sizes:

a. TB1: 4 feet height by 6 feet long.

3. Quantity:

a. Repair: 10
b. Maintenenace: 8

2.3 TACKBOARD ACCESSORIES:

A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch thick, extruded aluminum; of size and shape indicated.

1. Factory-Applied Trim: Manufacturer's standard.

2.4 FABRICATION:

A. Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.

B. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.5 ALUMINUM FINISHES:

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

D. Class II, Color Anodic Finish: AA-M12C22A32/A34 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, integrally colored or electrolytically deposited color coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motor-operated, sliding visual display units.

C. Examine walls and partitions for proper preparation and backing for visual display surfaces.

D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL:

A. General: Install visual display surfaces after furniture has been installed. Locations will be determined by the Engineer. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.3 CLEANING AND PROTECTION:

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 101100

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Panel signs.
2. Painted stencil signs.
3. Rated wall signs.

B. Related CSI Sections include the following:

1. Division 09 Section 099113, "Exterior Painting" for surface preparation and the application of paint systems for the stenciled substrates.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show fabrication and installation details for signs.

1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.

D. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available.

E. Sign Schedule: Use same designations indicated in this Section.

F. Quality Assurance Submittals:

1. Manufacturer Qualifications: Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

a. Two-Face Tape.
b. Silicone-Adhesive.

1.3 QUALITY ASSURANCE:

A. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).

2.2 PANEL SIGNS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Best Sign Systems Inc.
2. Mohawk Sign Systems.
3. Seton Identification Products.

B. Panel Signs, General: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.

Provide tactile and braille signs, through manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.

1. Sign Size: As required comply with character size requirements of ICC/ANSI A117.1.
2. Sign Material:

   a. Interior Signs: Acrylic sheet.
   b. Exterior Signs: Aluminum sheet.

3. Sign Thickness: 0.080 inch thick.
4. Sign Finish/Color: Manufacturer's standard/White.
5. Background Finish/Color: Matte-finished opaque/Dark Brown, Manufacturer's standard.

6. Text Font: Helvetica Medium.
7. Text Size: 0.0625-inch minimum.
8. Text and Graphic Color: White.
9. Tactile Text, Graphic and Braille Thickness: Not less than 1/32 inch.
10. Corner and Edge Condition: Square.
11. Mounting: Unframed.

    a. Interior Signs: Manufacturer's standard for substrates encountered.
    b. Exterior Signs: Manufacturer's standard non-corroding anchors for substrates encountered.

C. Panel Sign Types:

1. Type S1: Interior panel sign.
2. Type S2: Exterior panel sign.
3. Type S3: Interior panel sign, includes Men's or Women's graphic adjacent to the International Symbol for Accessibility on the same sign.
4. Type S4: Interior panel sign, includes graphic of person in motion towards a door.
5. Type S5: Interior panel sign, includes International Symbol for Accessibility.

    a. Height of graphic: 6-inch minimum.

2.3 STENCIL SIGNS:

A. Painted Stenciled Signs: Provide vinyl stencil signs to be painted only on the surfaces identified below, and will not be permitted to replace any panel signs:

1. Text Font: Helvetica Medium.
2. Text Size:

    a. Overhead Doors: 6 inches tall.
    b. Exterior Doors: 1 inch tall.

3. Paint Color: White to contrast with painted steel.
4. Numbering:

    a. Overhead Bay Doors: Consecutively number all overhead bay doors in the same order as the door number designation on plan, beginning with "1" at overhead bay door B1.
    b. Exterior Personnel Doors: Consecutively number all exterior personnel doors clockwise in ascending order, beginning with "EX-1" at the Entrance Door and continuing with "EX-2", "EX-3" etc. at subsequent doors.

2.4 RATED WALL SIGNS:

A. Firewall Signs: Provide plastic signs to be mounted above the ceiling on the one (1) hour and three (3) hour rated walls. Locate within 15 feet of the end of each wall and at intervals not to exceed 30 feet measured horizontally along the wall or partition:

1. Sign Size: 10 inches tall by 14 inches wide.
2. Text Size: not less than 3 inches tall with a minimum 3/8 inch stroke in a contrasting color incorporating the following words, “FIRE AND/OR SMOKE BARRIER – PROTECT ALL OPENINGS” or other wording.

2.5 FINISHES, GENERAL:

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ACRYLIC SHEET FINISHES:

A. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for five years for application intended.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.

1. Install signs level, plumb, and at heights complying with ICC/ANSI A117.1, with sign surfaces free of distortion and other defects in appearance.

2. Type S1, S3, S4: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
3. Type S2: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
4. Type S5: Install signs directly adjacent to Exit sign at level of exit discharge.

B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.

1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
2. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
3. Shim Plate Mounting: Provide 1/8-inch thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
4. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.

C. Painted Stenciled Signs: Comply with paint system application requirements of specification 099113.

1. Overhead Bay Doors: Stencil signs shall be painted on the exterior steel column on the door jamb side, 6 feet above grade.
2. Exterior Personnel Doors: Stencil signs shall be painted on the top of the exterior door frame and centered.

D. Rated Wall Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.

1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
2. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.

3.3 CLEANING AND PROTECTION:

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Engineer.

END OF SECTION 101400

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

B. Related CSI Sections:

1. Division 10 Section 102800, "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, and similar accessories.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

D. Samples for Initial Selection:

1. Physical color palette of manufacturer's full range of colors.

1.3 PROJECT CONDITIONS:

A. Field Measurements: Verify actual locations of plumbing fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PHENOLIC-CORE UNITS:

A. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Bobrick Washroom Equipment, Inc.
2. Bradley Corporation; Mills Partitions.
3. General Partitions Mfg. Corp.

B. Toilet-Enclosure Style: Overhead braced, Floor anchored.

C. Urinal-Screen Style: Wall hung.

D. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch thick doors and pilasters and minimum 1/2-inch thick panels.

1. Facing Sheet Color: One color in each room as selected by Designer from manufacturer's full range of colors.

a. Initial Color Selection: Tan.

2. Core Color: Manufacturer's standard dark color.

E. Pilaster Shoes and Sleeves (Caps): Fabricated from stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

F. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, stainless steel.
2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

2.2 ACCESSORIES:

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.3 FABRICATION:

A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

C. Door Size and Swings: Unless otherwise indicated, provide 30-inch wide, in-swinging doors for standard toilet compartments and 36-inch wide, out-swinging doors with a minimum 32-inch wide, clear opening for compartments designated as accessible.

1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
2. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities. Provide additional unit mounted 6 inches from the hinge side on the compartment side of the door; mounted between 26 and 36 inches above the finish floor.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

   a. Pilasters and Panels: 1/2 inch.
   b. Panels and Walls: 1 inch.

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.

   a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING:

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102213 – STORAGE CRIBS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Chain link fence and frame for tool crib/storage inside the building.

1.2 PERFORMANCE REQUIREMENTS:

A. Structural Performance: Chain link fence units shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to SEI/ASCE 7

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain link items.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Include clearances required for operation of gates.

1.4 QUALITY ASSURANCE:

A. Installer Qualifications:

1. Installer's responsibilities include fabricating and installing chain link fence items and providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of data for chain link fence items, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.5 PROJECT CONDITIONS:

A. Field Measurements: Verify actual dimensions of construction contiguous with chain link fence units by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Steel Wire: ASTM A 510 (ASTM A 510M).

B. Steel Plates, Channels, Angles, and Bars: ASTM A 36/A 36M.

C. Steel Pipe: ASTM A 53/A 53M, Schedule 40 unless another weight is indicated or required by structural loads. Pipe dimensions on the plans represent trade dimensions.

1. 2.375-inch actual OD = 2-inch NPS = 2.5-inch trade size.
2. 2.875-inch actual OD = 2.5-inch NPS = 3-inch trade size.
3. 3.500-inch actual OD = 3-inch NPS = 3.5-inch trade size.

D. Fasteners: Manufacturer's standard steel bolts, nuts, and washers.

E. Post installed Expansion Anchors: With capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Carbon Steel: Zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition (mild).
2. For Post installed Anchors in Concrete: Capability to sustain, without failure, a load equal to four times the loads imposed.
3. For Post installed Anchors in Grouted Masonry Units: Capability to sustain, without failure, a load equal to six times the loads imposed.

F. Seismic Bracing, if applicable: Angles with legs not less than 1-1/4 inch wide, formed from 0.04-inch thick, metallic-coated steel sheet; with bolted connections and 1/4-inch diameter bolts.

2.2 CHAIN LINK FENCE:

A. Refer to plans for design directions.

B. Chain Link Fence: 0.148-inch diameter, intermediate-crimp steel wire woven into 2-inch diamond mesh. Fabricated in one-piece widths for fencing 12 feet and less in height to comply with CLFMI "Product Manual".

1. Selvage: Knuckled at both selvages for fabric heights less than 72 inches.
2. Selvage: Knuckled at one selvage and twisted at the other for fabric heights 72 inches and over.

C. Framing: As detailed on the plans and indicated below.

1. Top, Bottom and Intermediate Horizontal Rails: Manufacturer's longest lengths (17 to 21 feet) with swedged-end or expansion-type coupling, approximately 6 inches long for joining. Provide rail ends or other means i.e. three- and four-way intersection connections for attaching rail securely to each gate corner, pull, and end post.

   a. 2" Round Steel: 1.900-inch OD Type I steel pipe.

2. Terminal (End, Line, and Corner) Posts for fabric heights over 6 feet:

   a. 3" Round Steel: 2.875-inch OD Type I steel pipe.

3. Swing Gate Posts: Furnish posts to support single gate leaf installation, according to ASTM F 900, sized as follows for steel pipe posts:

   a. Steel posts for fabric heights over 6 feet and gate leaf width up to and including 6 feet:

      1) 3" Round Steel: 2.875-inch OD pipe weighing at least 4.64 lb. per ft.

4. Top Capping Bars: Manufacturer’s standard.
5. Intersection connections shall be steel or malleable iron as required per mfr’s standards.

   a. For 90-Degree Corners: As detailed on the plans.
   b. Two-and Three-Way End Corner and Intersection Connections: As detailed on drawings.
   c. Three- and Four-Way Intersection Connections: As detailed on drawings.

6. Base Plates: Min. 6-by 6-inch galvanized steel plate sized to suit vertical framing, with pre-drilled holes for attachment to floor. Provide approximately 3 inches clear space between finished floor and bottom horizontal frame members.

D. Swing Gates: Comply with ASTM F900.

1. Swing Gate Steel Framing: Fabricate perimeter frames of gates from same material and finish as partition framework. Assemble gate frames with malleable corner fittings. Provide horizontal and vertical members to ensure proper gate

operation and attachment of fabric, hardware, and accessories. Space frame members maximum of 8 feet apart unless otherwise indicated.

a. 2" Round Steel: 1.900-inch OD Type II min., steel pipe.

2. Chain Link Fence: Same as partitions. Secure fabric at vertical edges with tension bars and bands and to top and bottom of frame with tie wires.
3. Bracing: Install diagonal cross-bracing consisting of 5/16-inch-diameter adjustable-length truss rods on gates to ensure frame rigidity without sag or twist.
4. Hinges: Non-lift-off type, sized to suite gate size, 1-1/2 pairs per door; bolted, riveted, or welded to door and jamb framing. Hinges shall permit 180-degree gate opening, where it allows.
5. Locking Hardware: Comply with the requirements of CSI Division 30 Section 304000 – "Fence and Gates", Subsection 2.1.A.7.

E. Accessories:

1. Post Caps: Provide weathertight closure cap for each post.
2. Post Brace Assembly: Manufacturer's standard adjustable brace. Brace, and truss to line posts with 3/8-inch diameter rod and adjustable tightener.
3. Tension or Stretcher Bars: Hot-dip galvanized steel with a minimum length 2 inches less than the full height of fabric, a minimum cross section of 5/16 inch by 3/4 inch, and a minimum of 1.2 oz. of zinc coating per sq. ft. Provide one bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into the post.
4. Horizontal Panel Stiffeners: As needed.
5. Tension and Brace Bands: 3/4-inch-wide minimum hot-dip galvanized steel with a minimum of 1.2 oz. of zinc coating per sq. ft.

   a. Tension Bands: 0.074 inch thick (14 gage) minimum.
   b. Brace Bands: 0.105 inch thick (12 gage) minimum.

6. Adjustable Filler Panels: Not less than 0.060-inch thick, cold-rolled steel sheet; capable of filling openings from 2 to 12 inches.
7. Wall Clips: Manufacturer's standard, cold-rolled steel sheet; allowing up to 1 inch of adjustment.

F. Finish for Uncoated Ferrous Steel: Hot-dip galvanized unless otherwise indicated.

2.3 FABRICATION:

A. General: Fabricate chain link fence items from components of sizes not less than those indicated. Use larger-sized components as recommended by chain link fence item manufacturer. As required for complete installation, provide bolts, hardware, and accessories with manufacturer's standard finishes.

1. Fabricate chain link fence items to be readily disassembled.

2. Welding: Weld corner joints of framing and finish sand.

B. Chain Link Fence: Fabricate chain link with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.

1. Chain Link: Securely clinch chain link to outside of framing. Pull chain link taut and secure to posts, rails, and tension wires.

a. Tension or Stretcher Bars: Thread through chain link and secure to end, corner, pull, and gate posts with tension bands.
b. Tension Bands: Use band of proper length to secure chain link firmly to posts and rails. Bend ends of band to minimize hazard to persons or clothing.

1) Maximum Spacing: Tie chain link to posts 12-inches on center and to rails and braces 24-inches on center

2. Framing: Fabricate framing with mortise and tenon corner construction.

a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by chain link manufacturer. Weld horizontal stiffeners to vertical framing.

3. Fabricate chain link fence with 2 inches of clear space between finished floor and bottom horizontal framing.
4. Gates: Align bottom of gate with bottom of adjacent panels.

a. For gates that do not extend full height of partition, provide transom over door, fabricated from same chain link and framing as partition panels.

5. Brace Assemblies: Install braces at end and gate posts and at both sides of corner and pull posts. Install so posts are plumb when diagonal rods are under proper tension.
6. Hardware Preparation: Reinforce, drill, and tap gates and framing as required to install hardware.

2.4 GENERAL FINISH REQUIREMENTS:

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.5 STEEL AND IRON FINISHES:

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123/A 123M, for galvanizing steel and iron components.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine floors for suitable conditions where chain link items will be installed.

C. Examine walls to which chain link items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CHAIN LINK FENCE ERECTION:

A. Anchor chain link fence to floor with 3/8-inch diameter, post installed expansion anchors at 12 inches o.c. through anchor clips located at each post and corner. Shim anchor clips as required to achieve level and plumb installation.

B. Anchor chain link fence to walls at 12 inches o.c. through back corner panel framing and as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.

C. Erect chain link fence as detailed on plans.

D. Provide seismic supports and bracing as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.

E. Install gates plumb, level, and secure for full opening without interference.

F. Weld or bolt sheet metal bases to chain link fence and gates where required.

G. Bolt accessories to chain link fence framing.

3.3 ADJUSTING AND CLEANING:

A. Adjust gates to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Remove and replace defective work including doors and framing that are warped, bowed, or otherwise unacceptable.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 102213

SECTION 102800 – TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Toilet Tissue Dispensers.
2. Paper Towel Dispensers.
3. Hand Dryers.
4. Waste Receptacles.
5. Soap Dispensers.
6. Grab Bars.
7. Sanitary Napkin Vendors.
8. Sanitary Napkin Disposal Units.
9. Mirrors.
10. Shower Curtain Rods.
11. Shower Curtains.
12. Robe Hooks.
13. Mop and Broom Holders.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish description.

1.3 QUALITY ASSURANCE:

A. Source Limitations: For products listed together in Part 2, provide products of same manufacturer unless otherwise approved by Designer.

1.4 COORDINATION:

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.

C. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

D. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

G. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 AVAILABLE MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. Kimberly-Clark Professional.

2.3 TOILET TISSUE DISPENSERS:

A. Double Toilet Tissue (Roll) Dispenser: DTTD, (3) Men’s Room; (2) Women’s Room.

1. Description: Double-roll dispenser.
2. Mounting: Surface mounted.

3. Operation: Eccentric-shaped, molded-plastic spindle; core cannot be removed until roll is empty.
4. Capacity: Designed to hold one full 12-inch diameter jumbo senior tissue roll and one roll stub. Toilet tissue used is Scott 07202.
5. Material and Finish: ABS plastic, gray.

2.4 PAPER TOWEL DISPENSERS:

A. Paper Towel (Roll) Dispenser: PTD, (1) Men's Room; (1) Women's Room; (1) Janitor's Closet; (1) at Breakroom Sink; (1) at Every Wash Fountain.

1. Description: No Touch, Automatic Roll Paper Towel Dispenser, 110-240VAC.
2. Mounting: Surface mounted.
3. Minimum Capacity: 8-inch wide, 800-foot long roll.
4. Material and Finish: Stainless steel, No. 4 finish (satin).
5. Maximum Dimensions: 13" wide x 17 ¾" high.
6. Lockset: Tumbler type and piano hinge.

2.5 HAND DRYERS:

A. Hand Dryers: (1) Men's Room; (1) Women's Room.

1. Description: Dyson Airblade dB hand dryer, 110-240VAC.
2. Mounting: Surface Mounted.
3. Material and Finish: Galvanized steel backplate/mounting bracket; Polycarbonate-ABS casing; Stainless steel finish.

2.6 WASTE RECEPTACLES:

A. Waste Receptacle: WR, (1) Men's Room; (1) Women's Room; (1) Breakroom; (1) Janitor.

1. Mounting: Freestanding.
2. Minimum Capacity: 21 gal.
3. Material and Finish: Stainless steel, No. 4 finish (satin).
4. Liner: Reusable vinyl liner.

2.7 SOAP DISPENSERS:

A. Liquid-Soap Dispenser: SD, (2) Men's Room; (1) Women's Room; (1) Breakroom; (1) Janitor's Closet; (1) at every wash fountain.

1. Description: No Touch, Designed for dispensing soap in liquid or lotion form.
2. Power: AC Adapter.
3. Mounting: Horizontally oriented, surface mounted.

4. Capacity: 33-oz minimum.
5. Finish: White.
6. Maximum Width: 6 ¼”.
7. Lockset: Tumbler type.
8. Refill Indicator: Window type.

2.8 GRAB BARS:

A. Grab Bar/Swing Up Grab Bar: GB, (3) Men’s Room; (3) Women’s Room/ SUGB, (1) Men’s Room; (1) Women’s Room.

1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 0.05 inch thick.

a. Finish: Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area.

3. Outside Diameter: 1-1/2 inches.
4. Configuration and Length: As indicated on the plans.
5. Bar mounting shall have minimum 300-lb. load capacity.

2.9 SANITARY NAPKIN VENDORS:

A. Vendor: SNV, (1) Women’s Room.

1. Type: Sanitary napkin and tampon.
2. Mounting: Surface mounted.
3. Capacity: Minimum 15 napkins and 20 tampons.
4. Operation: Single coin (25 cents).
5. Exposed Material and Finish: Stainless steel, No. 4 finish (satin)
6. Lockset: Tumbler type with separate lock and key for coin box.

2.10 SANITARY NAPKIN DISPOSAL UNITS:

A. Sanitary-Napkin Disposal Unit: SND, (2) Women’s Room.

1. Mounting: Surface mounted.
2. Door or Cover: Self-closing disposal-opening cover and hinged face panel with tumbler lockset.
3. Receptacle: Removable.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

2.11 MIRRORS:

A. Mirror Unit: M, (3) Men’s Room; (2) Women’s Room.

1. Frame: Stainless-steel angle, 0.05 inch thick, Stainless steel, fixed.

    a. Corners: Manufacturer's standard.

2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

    a. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.

3. Size: As indicated on the plans.

2.12 SHOWER CURTAIN RODS:

A. Shower Curtain Rod: SR, (3) Men's Room; (2) Women's Room.

1. Description: 1-inch OD; fabricated from nominal 0.0375-inch thick stainless steel.
2. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
3. Finish: No. 4 (satin).

2.13 SHOWER CURTAINS:

A. Shower Curtain: SC, (3) Men's Room; (2) Women's Room.

1. Size: Minimum 12 inches wider than opening by 72 inches high.
2. Material: Nylon-reinforced vinyl, minimum 10-oz. or 0.008-inch thick vinyl, with integral antibacterial agent.
3. Color: White.
4. Grommets: Corrosion resistant at minimum 6 inches o.c. through top hem.
5. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

2.14 ROBE HOOKS:

A. Robe Hook: RH, (2) Men's Room; (1) Women's Room.

1. Description: Double-prong unit.
2. Material and Finish: Stainless steel, No. 4 finish (satin).
3. Mounting: Surface-mounted, rectangular wall bracket with backplate for concealed mounting.

2.15 MOP AND BROOM HOLDERS:

A. Mop and Broom Holder: MH, (1) Janitor's Closet.

1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
2. Length: 36 inches.
3. Hooks: Three.
4. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

2.16 FABRICATION:

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to the Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING:

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.3 QUALITY ASSURANCE:

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by UL or FMG.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS:

A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.

1. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Amerex Corporation.
b. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
c. Potter Roemer LLC.
d. Tyco Fire Protection Products.

B. Multipurpose Dry-Chemical Type in Steel Container (Facility and Fuel Island): UL-rated 4-A:80-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

1. Quantity of Extinguishers: 20.

C. K-Guard Kitchen Hand Portable Extinguisher (Break Room): UL-rated 2-A:K, 1.6-gal capacity, with ANSULEX Low pH liquid agent in steel container.

1. Quantity of Extinguishers: 1.

2.2 MOUNTING BRACKETS:

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

1. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Amerex Corporation.
b. Badger Fire Protection; a Kidde company.
c. Potter Roemer LLC.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Engineer.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

C. Quantity of Mounting Brackets: 20.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Standard metal lockers.
2. Locker/Restroom benches.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.

1. Furnish bitting list for all locks cross referenced to each locker number.

C. Shop Drawings: For metal lockers. Include plans, elevations, sections, details, and attachments to other work.

1. Show locker trim and accessories.
2. Include locker identification system and numbering sequence.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.3 QUALITY ASSURANCE:

A. Source Limitations: Obtain metal lockers, benches, and accessories from single source from single manufacturer.

B. Regulatory Requirements: Where metal lockers are indicated to comply with accessibility requirements, comply with ICC/ANSI A117.1.

1. Provide not less than 1 shelf located no higher than 48 inches above the floor for side reach.

2. Provide hardware that does not require tight grasping, pinching, or twisting of the wrist, and that operates with a force of not more than 5 lbf.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.5 PROJECT CONDITIONS:

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.6 COORDINATION:

A. Coordinate sizes and locations of concrete masonry bases for metal lockers.

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

B. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

C. Anchors: Material, type, and size required for secure anchorage to each substrate.

1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and elsewhere as indicated, for corrosion resistance.
2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.2 STANDARD METAL LOCKERS:

A. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1. Lyon Workspace Products, LLC; Standard Lockers.

2. Penco Products, Inc.; Guardian Lockers.
3. Republic Storage Systems Company; Standard Lockers.

B. Locker Arrangement: Single tier.

C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet as follows:

1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch nominal thickness, with single bend at sides.
2. Backs and Sides: 0.024-inch nominal thickness, with full-height, double-flanged connections.
3. Shelves: 0.024-inch nominal thickness, with double bend at front and single bend at sides and back.

D. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.

1. Frame Vents: Fabricate face frames with vents.

E. Doors: One piece; fabricated from 0.060-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Doors less than 12 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
2. Doors for box lockers less than 15 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
3. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
4. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch nominal-thickness steel sheet; welded to inner face of doors.
5. Door Style: Vented panel as follows:

a. Louvered Vents: No fewer than six louver openings at top and bottom for single-tier lockers.

F. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

1. Continuous Hinges: Manufacturer's standard, steel, full height.

G. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.

1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.

    a. Latch Hooks: Equip doors 48 inches and higher with three latch hooks fabricated from 0.105-inch nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.

H. Cylinder Locks: Built-in, flush, cam locks with five-pin tumbler keyway, keyed separately and master keyed. Furnish two change keys for each lock and master keys.

1. Key Type: Grooved.
2. Bolt Operation: Automatically locking spring bolt.

I. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:

1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.

J. Accessories:

1. Continuous Sloping Tops: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch nominal-thickness steel sheet.

    a. Closures: Hipped-end type.
    b. Sloping-top corner fillers, mitered.

2. Filler Panels: Fabricated from 0.036-inch nominal-thickness steel sheet.
3. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet.
4. International Symbol of Accessibility Decal: Provide for each handicap accessible locker as indicated on plans, per manufacturer’s recommendations and complying with ICC/ANSI A117.1.

K. Finish: powder coat.

1. Color(s): Light Gray.

2.3 LOCKER/RESTROOM BENCHES:

A. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

1. Size: Minimum 9-1/2 inches wide and 1-1/2 inches thick with rounded corner and edges. The length shall be as indicated on the plans.
2. Size: ADA Bench - Minimum 20 inches wide and 42 inches long by 1-1/2 inches thick, with rounded corner and edges.

3. Laminated maple with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.

B. Fixed Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:

1. Tubular Steel: 1-1/4-inch diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed stainless steel fasteners.

a. Color: To match the locker color.

2.4 FABRICATION:

A. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.

C. Knocked-Down Construction: Fabricate metal lockers using nuts, bolts, screws, or rivets for nominal assembly at Project site.

D. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.

E. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.

F. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

1. Sloping-top corner fillers, mitered.

G. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

H. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.5 STEEL SHEET FINISHES:

A. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.

B. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

C. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. General: Install level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top and bottom of lockers of lockers and to floor.

B. Knocked-Down Metal Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.

C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach hooks with at least two fasteners.
2. Attach door locks on doors using security-type fasteners.
3. Identification Plates: Identify metal lockers with identification indicated on Plans.

    a. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

4. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Plans.
5. Attach sloping-top units to metal lockers, with closures at exposed ends.
6. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of non-recessed metal lockers.

D. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

E. Freestanding Locker/Restroom Benches: Place benches in locations indicated on plans.

3.3 ADJUSTING, CLEANING, AND PROTECTION:

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

SECTION 105700 - BAY FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Shelving
2. Storage Cabinets
3. Work Benches

1.2 PERFORMANCE REQUIREMENTS:

A. Structural Performance for Post-and-Beam Metal Storage Shelving: Capable of withstanding the loads indicated according to MH 28.2.

B. Seismic Performance: Metal storage shelving shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Seismic Component Importance Factor: 1.5.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include rated capacities, construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal storage shelving.

C. Shop Drawings: For customized metal storage shelving. Include plans, elevations, sections, details, and attachments to other work. Include installation details of connectors, lateral bracing, and special bracing.

D. Product Schedule: For metal storage shelving. Use same designations indicated on Plans.

E. Qualification Data: For qualified professional engineer.

1.4 QUALITY ASSURANCE:

A. Source Limitations: Obtain metal storage shelving from single source from single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Refer to Form 818 Article 1.06.03 and Form 818 Article 1.20-1.06.03 for additional information.

B. Environmental Limitations: Do not deliver or install metal storage shelving until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.6 COORDINATION:

A. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall and ceiling assemblies.

B. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, speakers, sprinklers, access panels, electrical switches or outlets, and floor drains.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Steel Tubing: ASTM A 513, Type 2.

C. Stainless-Steel Tubing: ASTM A 554, Grade MT-304.

D. Steel Wire: ASTM A 899.

2.2 REPAIR FACILITY

A. SHELVING:

1. Boltless Metal Storage Shelving “AA”: Factory-formed, field-assembled, freestanding system, designed for shelves to span between and be supported by corner posts, with shelves adjustable over the height of shelving unit. Fabricate initial shelving unit with a post at each corner. Fabricate additional shelving units similarly, so each unit is independent as add-on units, designed to share two corner posts with initial shelving unit. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.

a. Basis-of-Design Product: Subject to compliance with requirements, provide boltless shelving, as supplied by Grainger Item #1PWX5, EDSAL Model #HCU-963696, or an approved equal.
b. Load-Carrying Capacity per Shelf: 2600lbs.
c. Posts: Fabricated from cold-rolled steel; in manufacturer's standard shape; with perforations at 1-1/2 inches (38 mm) o.c. to receive shelf-to-post connectors.
   1) Steel Thickness, Nominal: 14-ga.

d. Solid-Type Shelves: Fabricated from steel sheet as follows:
   1) Steel-Sheet Thickness, Nominal: 16-ga.

e. Overall Unit Width: 96 inches
f. Overall Unit Depth: 36 inches.
g. Overall Unit Height: 96 inches.
h. Quantity: 34.

2. Bin Storage Shelving "BB": Factory-formed, field-assembled, freestanding system without back or end panels, designed for shelves to span between and be supported by corner posts, with shelves adjustable over the entire height of shelving unit. Fabricate initial shelving unit with a post at each corner. Fabricate additional shelving units similarly, so each unit is independent as add-on units, designed to share two corner posts with initial shelving unit. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.

   a. Basis-of-Design Product: Subject to compliance with requirements, provide Yellow Bins and Shelving as supplied by Grainger Item #7D417, EDSAL Model #2960, or an approved equal.
   b. Load-Carrying Capacity per Shelf: 400 lbs.
   c. Posts: Manufacturer's standard steel post with notches.
   d. Shelf Quantity: Ten shelves per shelving unit in addition to top and bottom shelf.
   e. Shelf-to-Post Connectors: Manufacturer's standard one-piece collet (wedge), designed to engage post collar attached to shelves.
   f. Bracing: Manufacturer's standard diagonal cross bracing, as required for stability, load-carrying capacity of shelves, and number of shelves.
   g. Overall Unit Width: 36 inches
   h. Overall Unit Depth: 12 inches.
   i. Overall Unit Height: 96 inches.
   j. Quantity: 10.
   k. Accessories:
      1) Shelf Inlay: Manufacturer's standard Yellow Bins.

3. Heavy-Duty Truck Tire Folding Rack "R": Factory-formed, field-assembled, freestanding system, designed for heavy truck and bus tires.

   a. Basis-of-Design Product: Subject to compliance with requirements, provide Martin Industries product #MLTFD, or an approved equal.

b. Tire Capacity: 1 to 8.
c. Load Capacity: 2400 lbs.
d. Max. Tire size: 44”O.D.
e. Overall Unit Width: 93-1/2 inches
f. Overall Unit Depth: 48 inches.
g. Overall Unit Height: 56-1/4 inches.
h. Quantity: 4, stacked 2 high.

4. 3-Tier Tire Shelving “Y”: Factory-formed, field-assembled, freestanding system, designed for light truck tires.

a. Basis-of-Design Product: Subject to compliance with requirements, provide Martin Industries product #MTS-92, or an approved equal.
b. Tire Capacity: 27 to 33.
c. Load Capacity: 1500 lbs.
d. Max. Tire size: 44”O.D.
e. Overall Unit Width: 92 inches
f. Overall Unit Depth: 16-3/8 inches.
g. Overall Unit Height: 92 inches.
h. Quantity: 1.

B. STORAGE CABINETS:
1. Combustible Cabinet “F”: Factory-formed, freestanding system.

a. Basis-of-Design Product: Subject to compliance with requirements, provide storage cabinet supplied by Ford & Ulrich part Justrite Sure-Grip EX Safety Cabinet model #H896000, or an approved equal.
b. Construction: Steel construction, powder coated Yellow finish with 2 doors and 2 shelves.
c. Overall Unit Width: 34 inches.
d. Overall Unit Depth: 34 inches.
e. Overall Unit Height: 65 inches.
f. Quantity: 1.

C. WORK BENCHES:
1. Typical Work Bench “A”: Factory-formed, field-assembled, freestanding system.

a. Basis-of-Design Product: Subject to compliance with requirements, provide work benches supplied by Rousseau SKU: GT-XKG0004S (Closed Bench), or an approved equal.
b. Construction: Partially assembled, painted steel “Classic Blue” color with stainless steel countertop.
c. Overall Unit Width: 60 inches.
d. Overall Unit Depth: 30 inches.
e. Overall Unit Height: 36 inches.
f. Doors: One door.

g. Drawers: Four drawers.
h. Quantity: 14.

2. Work Benches “WB”: Factory-formed, field-assembled, freestanding system.

a. Basis-of-Design Product: Subject to compliance with requirements, provide work benches supplied by Rousseau Model: WSA1975 (Closed Double Workbench), or an approved equal.
b. Construction: Partially assembled, painted steel countertop.
c. Overall Unit Width: 144 inches.
d. Overall Unit Depth: 30 inches.
e. Overall Unit Height: 34 inches.
f. Doors: Two sliding door.
g. Quantity: 1.

2.3 MAINTENANCE FACILITY

A. SHELVING:

1. Boltless Metal Storage Shelving “A”: Factory-formed, field-assembled, freestanding system, designed for shelves to span between and be supported by corner posts, with shelves adjustable over the height of shelving unit. Fabricate initial shelving unit with a post at each corner. Fabricate additional shelving units similarly, so each unit is independent as add-on units, designed to share two corner posts with initial shelving unit. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.

a. Basis-of-Design Product: Subject to compliance with requirements, provide boltless shelving, as supplied by Grainger Item #1PWX5, EDSAL Model #HCU-963696, or an approved equal.
b. Load-Carrying Capacity per Shelf: 2600lbs.
c. Posts: Fabricated from cold-rolled steel; in manufacturer's standard shape; with perforations at 1-1/2 inches (38 mm) o.c. to receive shelf-to-post connectors.
   1) Steel Thickness, Nominal: 14-ga.
d. Solid-Type Shelves: Fabricated from steel sheet as follows:
   1) Steel-Sheet Thickness, Nominal: 16-ga.
e. Overall Unit Width: 96 inches

f. Overall Unit Depth: 36 inches.
g. Overall Unit Height: 96 inches.
h. Quantity: 4.

2. Bin Storage Shelving “B”: Factory-formed, field-assembled, freestanding system without back or end panels, designed for shelves to span between and be supported by corner posts, with shelves adjustable over the entire height of shelving unit. Fabricate initial shelving unit with a post at each corner. Fabricate additional shelving units similarly, so each unit is independent as add-on units, designed to share two corner posts with initial shelving unit.

Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.

a. Basis-of-Design Product: Subject to compliance with requirements, provide Blue Bins and Shelving as supplied by Grainger Item #1UVT5, QUANTUM STORAGE SYSTEMS Model #WR6-973974BL, or an approved equal.
b. Total Load-Carrying Capacity: 5000 lbs.
c. Posts: Manufacturer's standard steel post with notches.
d. Shelf Quantity: Four shelves per shelving unit in addition to top and bottom shelf.
e. Shelf-to-Post Connectors: Manufacturer's standard one-piece collet (wedge), designed to engage post collar attached to shelves.
f. Bracing: Manufacturer's standard diagonal cross bracing, as required for stability, load-carrying capacity of shelves, and number of shelves.
g. Overall Unit Width: 36 inches.
h. Overall Unit Depth: 30 inches.
i. Overall Unit Height: 74 inches.
j. Quantity: 4
k. Accessories:
    1) Shelf Inlay: Manufacturer's standard Blue Bins.

B. STORAGE CABINETS:

1. Storage Cabinet, Welded, Charcoal Gray “C”: Factory-formed, freestanding, double handle, 3 point locking system. Steel construction with a powder coated finish, 4 adjustable shelves, 1 bottom shelve, floor levelers, knuckle hinges, 14ga door frame.
    a. Basis-of-Design Product: Subject to compliance with requirements, provide storage cabinet, as supplied by Grainger Item #1YHF6, HALLOWELL Model #HW4SC6178-4CL, or an approved equal.
        1) Steel Thickness, Nominal: 14-ga.
    b. Overall Unit Width: 36 inches.
    c. Overall Unit Depth: 21 inches.
    d. Overall Unit Height: 78 inches.
    e. Quantity: 4

2.4 COLD STORAGE

A. SHELVING:

1. Steel Pallet Rack “S”: Factory-formed, field-assembled, freestanding system designed for shelves to span between and be supported by end frames, with shelves adjustable over the entire height of shelving unit.
    a. Basis-of-Design Product: Subject to compliance with requirements, provide Steel Pallet Rack as supplied by Grainger Item # 59LA59, Mfr. Model #41D992, or an approved equal.
    b. Load-Carrying Capacity per Shelf: 19,380 lbs.
    c. Welded Upright Frame: Manufacturer’s standard post and bracing, frame construction with notches and footplates.

d. Pallet Rack Beam: Manufacturer's standard steel beam designed to engage post notches on upright frames.
e. Framed-Type Wire Shelves: Manufacturer's standard wire decking construction with metal plated decking.
f. Overall Unit Width: 96 inches.
g. Overall Unit Depth: 48 inches.
h. Overall Unit Height: 96 inches.
i. Quantity: 6.

2. Bulk Storage Rack "CSB" (Cold Storage Building): Factory-formed, field-assembled, freestanding system designed for shelves to span between and be supported by end frames, with shelves adjustable over the entire height of shelving unit.
   a. Basis-of-Design Product: Subject to compliance with requirements, provide Steel Pallet Rack as supplied by Grainger Item # 5JN30, Mfr. Model #DD67533SW, or an approved equal.
   b. Load-Carrying Capacity per Shelf: 10,000 lbs.
   c. No. of shelves: 4.
   d. Welded Upright Frame: Manufacturer's standard post and bracing, frame construction with notches and footplates.
   e. Wire Shelves: Manufacturer's standard wire decking.
   f. Overall Unit Width: 96 inches.
   g. Overall Unit Depth: 36 inches.
   h. Overall Unit Height: 96 inches.
   i. Quantity: 14.

2.3 FABRICATION:

A. Shop Fabrication: Prefabricate shelving components in shop to greatest extent possible to minimize field fabrication; temporarily preassemble shelving components where necessary to ensure that field-assembled components fit together properly. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Fabricate metal storage shelving square and rigid, with posts plumb and true and shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.

C. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

D. Form edges and corners free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a 1/2-inch wide hem on the concealed side; ease edges of metal plate to radius of approximately 1/32 inch. Shear and punch metals cleanly and accurately. Remove burrs.

E. Weld corners and seams continuously to develop strength, minimize distortion, and maintain the corrosion resistance of base metals. At exposed locations, finish welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces before finishing.

2.4 GENERAL FINISH REQUIREMENTS:

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. 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.

2.5 STEEL FINISHES:

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling."

B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry thickness.

2.6 STAINLESS-STEEL FINISHES:

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine floors for suitable conditions where metal storage shelving will be installed.

C. Examine walls to which metal storage shelving will be attached for properly located blocking, grounds, or other solid backing for attachment of support fasteners.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Vacuum finished floor and wet mop flooring over which metal storage shelving is to be installed.

3.3 INSTALLATION:

A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.
   1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
   2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
   3. Adjust post-base bolt leveler to achieve level and plumb installation.
   4. Install seismic restraints.
   5. Connect side-to-side and back-to-back shelving units together.
   6. Install shelves in each shelving unit at spacing indicated on Plans or, if not indicated, at equal spacing.
      a. Post-and-Beam Metal Storage Shelving: Install beams with beam-to-post connectors fully engaged in post perforations.

B. Install bins.

3.4 ERECTION TOLERANCES:

A. Erect metal storage shelving to a maximum tolerance from vertical of 1/2 inch in up to 10 feet of height, not exceeding 1 inch for heights taller than 10 feet.

B. Erect post-and-beam metal storage shelving to a maximum tolerance from vertical of 1/4 inch in 84 inches of height.

3.5 ADJUSTING:

A. Adjust metal storage shelving so that connectors and other components engage accurately and securely.

B. Adjust and lubricate operable components to operate smoothly and easily, without binding or warping. Check and readjust operating hardware.

C. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.

D. Replace metal storage shelving that has been damaged or has deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 105700

SECTION 111000 - VEHICLE SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping and tubing joining materials.
3. Compressed air powered linear reciprocating lube pumps.
4. Pump accessories.
5. Safety valves.
6. Spring driven open hose reel.
7. Hose reel accessories.
8. Dispensing valves.
9. Horizontal Steel Aboveground Storage Tank.
10. Fluid Disposal Pump System.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-105.02 and NOTICE TO CONTRACTOR-SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Also include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: For AST's, include details of supports. Indicate all critical dimensions, locations of all fittings, connections, and accessories.

D. Operation and Maintenance Data: Include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

E. Quality Assurance Submittals:

1. Field quality-control reports.

F. Welding certificates.

1.5 QUALITY ASSURANCE:

A. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel code.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Lift and support AST's only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tanks unless empty.

B. Other Tank Materials: Store material in a clean dry area protected from damage. Materials may be stored outside only with the written approval of the Engineer.

C. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 COORDINATION:

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of waste-oil storage tanks that fail in materials or workmanship within specified warranty period.

1. All pumps shall carry a minimum two-year warranty covering parts and on-site labor against defects in material or workmanship.
2. Storage Tanks:

a. Failures include, but are not limited to, the following when used for storage of waste-oil and waste anti-freeze at temperatures not exceeding 150 deg F:

i. Structural failures including cracking, breakup, and collapse.
ii. Corrosion failure including internal corrosion of steel tanks.

b. Warranty Period: 1 year from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS:

A. Steel Pipe:

1. ASTM A 106, seamless carbon steel pressure pipe, Schedule 40, Grade B.

a. Forged-Steel Threaded Fittings: ASTM A 182, Class 2000.
b. Forged-Steel Welding Fittings: ASTM A 182, Class 3000 for socket welding.

2. ASTM A 106, seamless carbon steel pressure pipe, Schedule 80, Grade B.

a. Forged-Steel Threaded Fittings: ASTM A 182, Class 6000.
b. Forged-Steel Welding Fittings: ASTM A 182, Class 6000 for socket welding.

B. Copper Tube: ASTM B 88, Type K seamless, drawn-temper, water tube.

1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type.

2.2 JOINING MATERIALS:

A. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.3 LINEAR RECIPROCATING COMPRESSED AIR POWERED LUBE PUMP:

A. General pump specification:

1. All lubricant pumps shall be designed to pump grease or oil to within one inch of the bottom of the product container to ensure maximum use of purchased material.
2. All pumps shall be designed to stand free of the bottom of the container to allow unobstructed flow of product to the pumping tube.
3. All pumps shall be of the self priming design. Pumps so designated for use in bulk supply tanks shall be equipped with a low oil shut off device to prevent free cycling of the pump in the event the product supply is exhausted.
4. All pumps shall have an air motor design with no metal to metal seals to prevent air leakage in the stalled condition. The air motor cylinder shall be of aluminum construction to prevent corrosion in the presence of a contaminated air supply.

The air piston shall be of one piece molded NBR construction to give a long trouble free service life. The air valve shall be of simplified construction with no more than three moving parts. The piston rod shall be finished to a surface tolerance of .25µm and hard electroless nickel coated for maximum seal life and low friction. Oil pumps shall be of the centerline design, for even wear distribution and minimal repair costs.

5. All pumps shall be equipped with bronze non wearing, non fouling, non corroding and non icing mufflers to meet and exceed OSHA recommendations for noise generation. Grease pumps shall be equipped with one muffler and oil pumps equipped with two.
6. All pumps shall be double acting to provide continuous even flow and pressure and maximum utilization of the compressed air supply.
7. All pumps shall have primary and secondary self-lubricating throat seals constructed of copper impregnated PTFE number 46 with Nitrile back up rings.
8. All pumps shall have case hardened seats and ball checks for maximum service life and resistance to damage from contaminated product.
9. All pumps shall be easily serviceable with no special tools required.
10. All pumps shall be individually factory tested and verified for proper function. This test shall consist of a minimum of one-hour intermittent operation pumping product against full operating pressure.

B. 5:1 Ratio Stub Type Pump for use in High Volume Fluid Distribution Systems, which include Pipe Lines, Hose Reels, and Metered Control Handles:

1. This pump shall be a 5:1 ratio stub type pump for use in high volume fluid distribution systems which include pipe lines, hose reels, and metered control handles. This pump shall be capable of servicing multiple outlets simultaneously. In addition to meeting all of the general pump specifications, this pump shall also have the following features. Construction of corrosion resistant parts including aluminum and alloy steel, with polyurethane and Nitrile seals. This pump shall be compatible with all types of mineral and most synthetic oils, high viscosity gear oils, diesel and kerosene. Also able to pump non-corrosive liquids of high viscosity that are compatible with the materials listed above.
2. This pump shall have an air motor diameter of 3 1/2 inches and a minimum 4-inch pumping stroke.
3. This pump shall have an air inlet of 3/8” NPTF and fluid outlet of 1” NPTF.
4. This pump shall have a 1” NPTF fluid inlet connection threads for wall mounting or custom suction tube lengths, as well as outside O ring sealed machine threads for optional standard length suction tubes available for all standard dispensing containers.
5. This pump shall be rated for and capable of operating at a minimum air pressure of 40psi and maximum air pressure of 140psi. The maximum fluid pressure will be 700psi.
6. This pump shall be capable of producing a maximum free flow rate of 10 gallons per minute, with a maximum discharge head @140psi of 1,795 feet.

7. This pump shall have an average air consumption no greater than 7 CFM @ 100psi.
8. This pump shall include a 2” die cast metal sliding bung mounting adapter to allow infinite adjustment of the depth of the pump in the product container.

2.4 PUMP ACCESSORIES:

A. Service shut off valve:

1. All pumps shall be equipped with a service shut off valve to isolate the pump from the system for testing or service. This valve shall be rated for a working pressure greater than the maximum output pressure of the pump for which it is intended.
2. Service valves include medium-pressure 1/2”, 3/4” and 1” valves, and high-pressure 1/2”, 3/4” and 1” valves.

B. Follower plate:

1. All grease pumps shall be equipped with follower plates constructed of steel with flexible seals and a handle for easy transfer.
2. This follower plate shall be for 120 lb. Containers and 400 lb. Containers.

C. Filters regulators and lubricators:

1. Each compressed air powered linear reciprocating lube pump shall have incorporated into its supply line a filter, regulator and lubricator assembly. This assembly shall be securely mounted to the wall. The filter shall be equipped with an automatic drain and the regulator shall be equipped with an air gauge.
2. Each compressed air powered diaphragm pump shall have incorporated into its supply line a filter regulator assembly. This assembly shall be securely mounted to the wall. The filter shall be equipped with an automatic drain and the regulator shall be equipped with an air gauge.

2.5 SAFETY VALVES:

A. Air Safety Valves: Compliant with FM Global 7-32, FM Approved Firesafe Valve.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Series B219VS Ball Valve as manufactured by Belimo or an approved equal.
2. Rating: 600 psig minimum.
3. Ends: SAE NPT
4. Stem Packing: Reinforced PTFE
5. Ball: Stainless Steel
6. Body: Bronze

B. Lubricant Safety Valves (Grease): Compliant with FM Global 7-32, FM Approved Firesafe Valve.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Series H71 Valve as manufactured by Worcestor Controls or an approved equal.
2. Rating: 5000 psi minimum.
3. Size: ¾”
4. Ends: NPT

C. Lubricant Safety Valves (Oil): Compliant with FM Global 7-32, FM Approved Firesafe Valve.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Series 4 Valve as manufactured by Worcestor Controls or an approved equal.
2. Rating: 2000 psi minimum.
3. Size: ¾”
4. Ends: NPT

D. Safety Valves Actuators: Compliant with FM Global 7-32.

5. Basis-of-Design Product: Subject to compliance with requirements, provide Series NFB24 Actuator as manufactured by Belimo or an approved equal.
6. Power Supply: 24V D/C
7. Torque: 90 in-lb minimum
8. Action: Power open, normally close spring return.
9. Actuator shall be compatible with all safety valves listed in this section.

2.6 SPRING DRIVEN OPEN HOSE REELS:

A. General specification:

1. All reels shall be constructed of powder coated carbon steel for maximum durability.
2. All reels shall have double pedestal side supports and dual hose guide arms, adjustable for wall, ceiling, or floor mounting.
3. All reels shall have a powder coated welded carbon steel reinforced base to resist deformation from operator induced side loading.
4. All reels shall have heavy duty hubs constructed of brass for maximum durability, product compatibility, interchangeability, and corrosion resistance. Hubs shall be full flow ported and rated for a maximum pressure of 9,000psi.
5. All reels shall have a heavy-duty four-piece roller outlet assembly for maximum hose life.
6. All reels shall have a safety wound and riveted steel spring rated for a minimum of 50,000 cycles. This spring to be mounted in a steel canister for safe removal during service operations. This spring shall have a free float mounting to prevent damage from uncontrolled hose flyback.

7. All reels shall have a conical hose stopper for operator safety when retracting the hose.
8. All reels shall have a minimum of nine possible locking positions on the positive latching mechanism. The latch pawl shall be constructed of nickel plated steel for maximum durability. Latch mechanism shall be of the non-sparking design.
9. All reels shall be have a hub mounted spring tension adjuster for simplified adjustments that do not require removal of the control handle or relief of the system pressure.
10. Swivels for the reels shall be as follows. High pressure swivels shall be constructed entirely of alloy steel and have a full circumference polyurethane lip seal. Medium and Low pressure swivels shall be constructed of alloy steel and brass for maximum corrosion resistance and have a full circumference Nitrile lip seal.
11. Hoses for the reels shall be as follows. Low-pressure hoses shall be fabric reinforced with permanent hose ends. Medium pressure hoses shall be wire reinforced and flame resistant with permanent hose ends. High pressure hoses shall be multiple wire reinforced and flame resistant with permanent hose ends. All hoses shall have a swivel fitting on one end to facilitate installation and service.

B. Heavy duty large capacity hose reels:

1. In addition to meeting all of the general specifications, reel shall have a maximum capacity of up to 60’ of 1/2” hose.
2. Reel shall have a welded powder coated carbon steel base and constructed of 50% thicker gauge steel than a standard duty reel.
3. Reel shall be equipped with an extended wrap free-floating retraction spring for longer hose length capacities.
4. Reel shall have a separate mounting base constructed of three plates of steel for the previously specified hose roller outlet.
5. Reel shall be equipped with a solid steel reinforcing tie bar connecting the dual outlet arms.

2.7 HOSE REEL ACCESSORIES:

A. Reel mounting channels and brackets:

1. Reel banks shall be mounted on a predrilled, powder coated carbon steel mounting channel. Attach reel mounting channel to reel system support structure using manufacturer approved methods.

B. Inlet connection hose:

1. All reels shall be furnished with an inlet connection hose of identical construction as the previously specified outlet hoses to isolate the reel from the supply piping.

The inlet connection hose shall be two feet in length and the same diameter as the outlet hose.

C. Service shut off valve:

1. All hose reels shall be equipped with a service shut off valve to isolate the reel from the system for testing or service. This valve shall be rated for a working pressure greater than the maximum output pressure of the pump which is supplying it.

2.8 DISPENSING VALVE:

A. Low pressure control handles:

1. Water control valves shall be constructed of corrosion resistant metal with a positive sealing valve.

B. Medium pressure control handles:

1. All mechanical pistol grip or inline style metering control valves shall be constructed primarily of aluminum alloy for lightweight, corrosion resistance, and reduced operator fatigue. The body of the valve shall be ergonomically designed for operator comfort. The face of the meter shall feature a pointer with adequate markings to easily read the quantity of product being dispensed. The face of the meter shall also contain a non-resettable totalizing register. The valve shall be full flow ported and positive sealing. These control handles shall be available with a minimum of four different styles of outlet tube assemblies that are easily interchangeable for maximum versatility. These outlet tube assemblies shall feature semi automatic positive sealing anti drip tips to maintain a safe and clean work environment.
2. All electronic pistol grip or inline style metering control valves shall be constructed primarily of aluminum alloy for lightweight, corrosion resistance, and reduced operator fatigue. The body of the valve shall be ergonomically designed for operator comfort. The face of the meter shall feature a large LCD display with adequate markings to easily read the quantity of product being dispensed. The display of the meter shall also contain an easily accessible totalizing register. The valve shall be full flow ported and positive sealing. These control handles shall be available with a minimum of four different styles of outlet tube assemblies that are easily interchangeable for maximum versatility. These outlet tube assemblies shall feature semiautomatic positive sealing anti drip tips to maintain a safe and clean work environment.
3. Non metered style control valves shall be constructed primarily of aluminum alloy for light weight, corrosion resistance, and reduced operator fatigue. The body of the valve shall be ergonomically designed for operator comfort. The valve shall be full flow ported and positive sealing. These control handles shall be

available with a minimum of four different styles of outlet tube assemblies that are easily interchangeable for maximum versatility. These outlet tube assemblies shall feature semi automatic positive sealing anti drip tips to maintain a safe and clean work environment.

4. All medium pressure control valves shall be rated for a maximum working pressure of 1,500psi. All medium pressure control handles shall feature inlet filter screens. Unitized pistol grip style control handles shall feature an infinite rotation swivel sealed with a Nitrile O ring and a PTFE back up washer. All other medium pressure metered and non metered control valve assemblies shall feature a ball bearing infinite rotation swivel sealed with a Nitrile O ring and a PTFE back up washer. All medium pressure swivels shall have 1/2" NPTF inlet threads.

C. Medium pressure high volume control handles:

1. Medium pressure high volume control valves shall be constructed primarily of alloy steel with an aluminum alloy housing for light weight, corrosion resistance, and reduced operator fatigue. The housing of the valve shall be ergonomically designed for operator comfort. The valve shall be full flow ported and positive sealing, with a dual valve for both high and low flow dispensing. The handle shall be equipped with a spring loaded retention mechanism for hands free dispensing and a semi automatic positive sealing anti drip tip to maintain a safe and clean work environment.
2. All medium pressure high volume control valves shall be rated for a maximum working pressure of 1,800psi.
3. All medium pressure high volume control valve assemblies shall feature on the inlet a ball bearing infinite rotation swivel sealed with a Nitrile O ring and a PTFE back up washer and have 1/2" NPTF inlet threads.

D. Y Strainer inline filter:

1. This inline filter shall be constructed of cast iron for durability. It shall have 1/2" NPTF ports for simplified installation. This filter shall be of the inline 'Y' design to allow cleaning of the filter screen without removal of the housing from the line.

2.9 CONCEALED FLOOR ANCHOR:

A. Factory formed with a cover, cast-in-place designed system to be used as a full-functioning tie down for automotive and frame correction.

1. Basis-of-Design Product: Subject to compliance with requirements, provide concealed floor anchor system Model # B525 as manufactured by Buske L.L.C., or an approved equal.
2. Anchor Rod Diameter: 1".
3. Opening Size: Approximately 8-½" by 5".
4. Cover: Flush with finished grade.
5. Allowable Tensile Load: Tested to a minimum of 50,000 lbs.

2.10 HORIZONTAL, STEEL, ABOVEGROUND STORAGE TANK:

A. Basis-of-Design Product: Subject to compliance with requirements, provide Lube Cube as manufactured by Containment Solutions, Inc., or an approved equal. Quantity (4) four for this project.

B. Description: UL 142, double-wall, horizontal, steel tank; with primary- and secondary-containment walls and interstitial space.

C. Construction: Fabricated with welded, carbon steel; suitable for operation at atmospheric pressure and for storing oil with specific gravity up to 1.1 and with maintained temperature up to 150 deg F.

D. Supports: Manufacturer's standard structural steel welded to tank.

E. Capacities and Characteristics:

1. Capacity:

a. Waste Oil: 500 gallons.
b. Waste Antifreeze: 500 gallons.
c. Motor Oil and Hydraulic Oil: 330 gallons.

2. Connection Sizes:

a. Fill: 2-inch NPS.
b. Primary Vent Line: 2-inch NPS.
c. Mechanical Gage: 2-inch NPS.
d. Emergency Vent: 4-inch NPS.
e. Secondary Vent: 2-inch NPS.
f. Secondary Monitoring Port: 2-inch NPS.
g. Secondary Emergency Vent: 4-inch NPS.
h. Pump-out Port: 2-inch NPS.

2.11 ABOVEGROUND STORAGE TANK ACCESSORIES:

A. Threaded pipe connection fittings on top of tank, for fill, vent, outlet, sounding, and gaging. Include cast-iron plugs for shipping.

B. Lifting Lugs: For handling and installation.

C. Pump-Out Assembly: Piping fitting with end cap with locking cam arms.

D. Pump-Out Tube: Extension of pump-out piping fitting into tank, terminating 6 inches above tank bottom.

E. Spillbox: Construction to match tank, stainless steel fasteners, welded to top of primary tank. Spillbox shall have a screen in the bottom.

F. Mechanical Level Gauge: 2” NPT, molded float, impervious to petroleum products, break resistant vile with UV inhibitors, to fit depth of tank required.

G. Weatherproof Vent Cap: Open, atmospheric type, corrosion-resistant, internal wire screen designed to protect vent lines from water, debris, and insects.

H. Emergency Response Identification: Hazard sign that meets the requirements of NFPA 704. Hazard rating numerals shall be a minimum of 3 inches high. Sign shall be vinyl with self adhesive backing, intended for outdoor use.

2.12 TANK INSTALLATION MATERIALS:

A. Concrete Pads: Comply with the requirements in CSI Division 03 Section 033000, “Cast-in-Place Concrete.”

2.13 SOURCE QUALITY CONTROL:

A. Pressure test and inspect fuel-oil storage tanks, after fabrication and before shipment, according to ASME and the following:

1. Horizontal, Double-Wall Steel ASTs: UL 142, STI F921, and STI R931.

B. Affix standards organization's code stamp.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install lubrication pumps and systems equipment level and plumb, and in accordance with manufacturer’s written installation instructions.

B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

C. Install piping adjacent to equipment and machines to allow service and maintenance.

D. Install piping free of sags and bends.

E. Install fittings for changes in direction and branch connections.

F. Coordinate location and installation of concealed floor anchors with concrete slab pour.

3.2 JOINT CONSTRUCTION:

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints for Steel Piping: Join according to AWS D10.12/D10.12M.

3.3 ABOVEGROUND STORAGE TANK INSTALLATION:

A. Set tank on concrete pad.

B. Install tank bases and supports.

C. Connect piping and vent fittings.

D. Install ground connections.

E. Install steel ASTs according to STI R912.

F. Apply Hazard Sign directly to tank in a visible location. Hazard ratings shall be the following:

1. Waste Oil:

a. Health (Blue): 0
b. Fire (Red): 2
c. Instability (Yellow): 0
d. Special Hazard (White): None

2. Waste Antifreeze:

a. Health (Blue): 1
b. Fire (Red): 1
c. Instability (Yellow): 0
d. Special Hazard (White): None

3. Motor Oil:

a. Health (Blue): 0
b. Fire (Red): 1
c. Instability (Yellow): 0

d. Special Hazard (White): None

4. Hydraulic Oil:

a. Health (Blue): 0
b. Fire (Red): 1
c. Instability (Yellow): 0
d. Special Hazard (White): None

3.4 FLUID DISPOSAL PUMP SYSTEM INSTALLATION:

A. Install system components as per Manufacturer's instructions.

B. Install piping and pipe connections as per Manufacturer's instructions and applicable sections of this Specification.

C. Install suction piping with minimum fittings and change of direction.

3.5 HANGER AND SUPPORT INSTALLATION:

A. Comply with requirements in CSI Division 22 Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

B. Vertical Piping: MSS Type 8 or 42, clamps.

C. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

D. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

E. Base of Vertical Piping: MSS Type 52, spring hangers.

F. Support horizontal piping within 12 inches of each fitting and coupling.

G. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 to NPS 1/2: 96 inches with 3/8-inch rod.
2. NPS 3/4 to NPS 1-1/4: 84 inches with 3/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

3.6 CONCRETE BASES:

A. Concrete and reinforcement as specified in CSI Division 03 Section 033000, "Cast-in-Place Concrete." Concrete bases shall be installed by the Concrete Installer in the location indicated by the Mechanical Installer.

B. Concrete Bases: Anchor waste oil tank to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

3.7 PIPING SCHEDULE:

A. Oil piping shall be the following:

1. Schedule 40, steel pipe; threaded or welded forged-steel fittings; and threaded or welded joints.

3.8 FIELD QUALITY CONTROL

A. Provide hydrostatic testing to comply with testing of metallic Category D and Normal fluid service process piping system constructed to ASME B31.3 “Process Piping. Nonmetallic piping and other fluid service categories have additional requirements.

1. Test medium shall be oil or water.

a. If water is used in piping systems for oils/grease, the piping must be dried after test.
b. If oil is used in piping system for antifreeze, the piping must be cleaned of oil and dried after test. Piping systems are to be free of containments after tests have been complete.

B. General Test Preparation:

1. All code and design required examinations shall be complete prior to testing.
2. A preliminary walk-down of the piping to be tested shall be made. Test personnel shall correct and./or identify test boundaries, any problems, incomplete items, joint access, fill points, vent points, and any scaffolding required.
3. All joints, including welds and mechanical joints are to be left un-insulated and exposed for examination during the test, except that joints previously tested may be insulated or covered.
4. Hangers and supports shall be placed in the proper position prior to the filling of the system to be tested.
5. Piping designed for vapor or gas shall be provided with additional temporary supports, if necessary to support the weight of the test liquid, as designated by the DESIGNER. Spring hangers should be placed in the locked position.
6. Expansion joints shall be provided with temporary restraint if required for additional pressure load under test, or shall be isolated from the test.

7. The test personnel shall assure that the components (e.g. instruments, valves, etc.) that are not to be subjected to the pressure test, are either disconnected from the piping or isolated by blind flanges or other means during the rests. Valves may be used for isolation, provided the valve (including the closure mechanism) is suitable for the proposed test pressure.
8. A flanged joint at which a blank is inserted to isolate other equipment during the test need not be examined for leaks. These joints should be leak tested during initial service.
9. If a pressure test is to be maintained for a period of time and the test liquid in the system is subject to changes in temperature, precautions shall be taken to avoid excessive pressure due to thermal expansion or freezing.
10. A preliminary air test at not more than 25 psi gage pressure may be made prior to hydrostatic test in order to locate major leaks
11. A test record shall be made for each leak test. The record shall include the following:

    a. Date of test
    b. Identification of piping to be tested (test boundaries)
    c. Test fluid
    d. Test pressure
    e. Certification of the examiner

12. Following hydrostatic testing, the piping system shall be cleaned, and dried if necessary.
13. Prior to in-service leak test, the piping system shall be cleaned, and dried if necessary.
14. During hydrostatic testing or in-service leak testing, strainers shall be used to protect equipment against the introduction of construction debris and/or dirt.

C. Hydrostatic Leak Testing Test Fluid:

1. The test fluid shall be water unless there is a possibility of damage due to freezing, or if the process or piping material would be adversely affected by water. In that case, other suitable test fluids may be be used. Special precautions are required if the rest fluid is toxic or flammable.
2. The temperature of the rest fluid shall be no less than 40 F in piping systems subject to brittle factor (i.e. carbon steel).
3. If test fluid temperature produces condensation on the piping exterior surface, the water shall be heated to a temperature above the dew point or the test shall be postponed to a time when the dew point temperature has changed sufficiently such that condensation will not occur on the piping exterior surface.
4. Material and test water temperatures shall be approximately equal prior to pressurizing the system.
5. High points in the system shall be vented so that air will be displaced while the system is being filled with the test fluid.

6. The operator shall take adequate measures to ensure that the piping system is not over-pressurized during hydrostatic testing. Adequate measures include a relief valve, or a dedicated operator to monitor pressure, or dual pressure regulators, etc.

D. Test Pressure:

1. Normal operating pump discharge pressures:

   a. Grease Pump: normal operating discharge pressure is 4000 psi
   b. Oil(s) Pump: normal operating discharge pressure is 1125 psi
   c. Anti-freeze Pump: Normal operating discharge pressure is 100 psi
   d. Used antifreeze evacuation system: Normal operating discharge pressure is 100 psi

2. The maximum test pressure shall not exceed 1.5 times the pumps normal operating discharge pressure or the working pressure or yield stress of any component or vessel in the system.

   a. When a maximum test pressure is specified, the test pressure shall not exceed this amount.
   b. When no maximum test pressure is specified, the test shall not be greater than 110% of the minimum.

3. The minimum hydrostatic test pressure for metallic piping shall be per the following equation.

   a. PT = 1.5 PD x ST/SD

      1) Where: PT = minimum test gage pressure)
      2) PD = internal design gage pressure
      3) ST = allowable stress value at test temperature
      4) SD = allowable stress value at design temperature
      5) Note: The maximum allowable value of ST/SD is 6.5

4. When using water, static head due to differences in the elevation of the top of piping system and the elevation of the test gage shall be accounted for in pressuring the piping system to be tested by the following equations:

   a. SH (psi) = (HE – GE) x 0.433
   b. PST = PT + SH

      1) Where: HE = high point elevation (ft)
      2) GE = gage point elevation (ft)
      3) SH = static head (psi)
      4) PST = minimum test gage pressure corrected for static head.
      5) Note: 0.433 = conversion factor (ft of water to psi)

5. Pressure gages shall be connected directly to piping. Calibrated pressure gages shall be used in all Code testing. Pressure gage range shall exceed the intended test pressure by approximately double but in no case shall the range be less than one and one-half (1 ½) times the test pressure.

E. Hydrostatic Testing of Piping with Vessels as a System:

1. Where a test pressure of piping attached to a vessel is the same as or less than the test pressure for the vessel, the piping may be teste with the vessel at the test pressure of the piping.
2. Where the test pressure of the piping exceeds the vessel test pressure and isolation is not considered practicable, the piping and the vessel may be tested together at the test pressure of the vessel, if approved by the DESIGNER. The vessel test pressure must not be less than 77% of the piping test pressure.

F. Examination for Leaks:

1. Test personnel shall ensure the hydrostatic pressure is maintained for sufficient time to determine if there are any leaks. A minimum time of 10 minutes is required by Code. After hydrostatic pressure time has been satisfied, all joints shall be examined visually for leaks.
2. Examination shall be made of all welds and mechanical joints. There shall be no visible evidence of leakage. Welds and joints previously tested need not to be examined for leaks.
3. Leakage detected in welded joints shall be repaired by draining, repair welding, non-destructively examining in accordance with original requirements, and re-tested to the original test pressure.
4. Mechanical joint leakage at permanent joints shall be repaired, examined in accordance with original requirements, and re-tested to original test pressure.

G. Cleaning and Drying:

1. Clean and dry piping as required to remove all of the test media used so as not to contaminant different materials being used in piping distribution systems.

3.9 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

END OF SECTION 111000

SECTION 111400 - VEHICLE WASHING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the vehicle washing equipment that will operate on the building utilities.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include rated capacities of selected model clearly indicated, furnished specialties and accessories.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Field quality control test reports specified in Part 3.2, "Field Quality Control."

1.4 CLOSEOUT SUBMITTALS:

A. Maintenance Data: Include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2.1 VEHICLE WASHING EQUIPMENT:

A. Subject to compliance with requirements, the vehicle washing equipment shall be a customized Model No. SP-400, referred to as Model No. CW425T, as manufactured by Power America (telephone number 1-800-462-4008), or an approved equal.

B. The vehicle washing equipment shall be suitable for the use of either hot or cold water, and shall include the following accessories and design criteria:

1. Finish: Manufacturer's standard.
2. Construction: Stainless steel cover on a tubular steel frame.
3. Mobility cart (wheels and handle).
4. 50-ft of hose and hose rack.
5. Tip holder.
6. Water Pump Volume: 4.5-gpm.
7. Water Pump Pressure: 2500-psig.
8. Electric Motor: 7.5-hp, 208-V, 60-Hz, 3 phase, drip-proof, with thermal overload protection.
9. Power cord with plug.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Assemble equipment delivered unassembled in accordance with manufacturer's recommendations.

B. Coordinate the installation of the vehicle washing equipment with the construction of the facility.

3.2 FIELD QUALITY CONTROL:

A. Engage a factory-authorized service representative to test all operating functions of the vehicle washing equipment after installation. Damaged or defective equipment, materials, and workmanship shall be repaired or replaced, and the test shall be repeated. The Owner will provide vehicles to be used during testing.

3.3 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative to instruct Owner's personnel in operating and routine maintenance service procedures to be used with the vehicle washing equipment. The Owner will provide vehicles to be used during training.

END OF SECTION 111400

SECTION 113100 - APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Cooking equipment including:

a. Microwave oven.
b. Electric Range.

2. Refrigerator/freezer.

B. Related CSI Sections include the following:

1. Division 12 Section 123530, “Casework” for casework.
2. Division 23 Section 233813, “Commercial-Kitchen Hoods” for exhaust hood.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include operating characteristics, dimensions of individual appliances, and finishes for each appliance.

C. Maintenance Data: For appliances to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.3 QUALITY ASSURANCE:

A. Source Limitations: Obtain appliances through one source from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

1. Provide products from same manufacturer for each type of appliance required.

B. Regulatory Requirements: Comply with provisions of the following product certifications:

1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2. UL and NEMA: Provide electrical components required as part of appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
3. NAECA: Provide appliances that comply with NAECA standards.

C. Regulatory Requirements, Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with ANSI A117.1.

1. Operable Parts: Provide controls with forward reach no higher than 48 inches above the floor, horizontal front reach no more than 25 inches, horizontal side reach no more than 24 inches, and that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Refrigerator/Freezer: Provide 50 percent of freezer space within 54 inches of the floor.

D. Energy Ratings: Provide residential appliances that carry labels indicating energy-cost analysis (estimated annual operating costs) and efficiency information as required by the FTC Appliance Labeling Rule.

1. Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, manufacturers specified.

1. General Electric Company.
2. Whirlpool.

2.2 COOKING APPLIANCES:

A. Microwave Oven:

1. Oven(s): Standard features include the following:

a. Oven Capacity: 2.0 cu. ft.
b. Oven Features: Digital control panel with timer display, turntable, and temperature probe.
c. Mounting: Freestanding.
d. Electrical Power: 1000 W.
e. Oven Door: Counter-balanced, removable, porcelain enamel finish with observation window.

f. Color: White.

B. Electric Range: ADA compliant slide-in range with one oven and complying with AHAM ER-1.

1. Width: 30 inches.
2. Electric Burner Elements: Four minimum.

a. Radiant Type: Two 1200 W minimum and two 2000 W elements.
b. Controls: Digital panel controls, located on front panel of range top.

3. Oven Features:

a. Capacity: 4.8 cu. ft. minimum.
b. Operation: Baking and pyrolytic self-cleaning.
c. Broiler: Located in top of oven.
d. Oven Door: Counterbalanced, removable, with observation window and full-width handle.
e. Electric Power Rating:

1) Oven(s): 2400 W minimum.
2) Broiler: 3400 W minimum.

f. Controls: Digital panel controls and timer display, located on front panel of range top.

4. Anti-Tip Device: Manufacturer's standard.
5. Electric Power Supply: As indicated on Electrical Drawings.
6. Material: Manufacturer's standard cooktop.

a. Color/Finish: White.

7. Comply with accessibility requirements.

2.3 REFRIGERATION APPLIANCES:

A. Refrigerator/Freezer:

1. Type: Freestanding, frost-free, side-by-side refrigerator/freezer.
2. Storage Capacity:

a. Fresh Food Compartment Volume: 16.5 cu. ft.
b. Freezer Volume: 9.5 cu. ft.
c. Shelf Area: 3 adjustable glass shelves, 26 sq. ft.

3. Refrigerator Features:

a. Compartment Storage: Vegetable crisper, Meat compartment.

b. Door Storage: Dairy compartment, Modular compartments.

4. Freezer Features:

a. Ice storage bins.
b. Automatic icemaker and storage bin.
c. Circulator fan.
d. Ice and cold-water dispenser in the door.

5. Energy Consumption: Measured and certified by AHAM HRF-1 at not more than 688 kWh/year under average conditions for a refrigerated volume of 17.9 cu. ft.
6. Temperature Controls: Separate temperature controls for each compartment and with switch for condensation-control heating element at freezer opening.
7. Appliance Color: White.

2.4 FINISHES, GENERAL:

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Color-Coated Finish: Provide appliances with manufacturer's standard finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, color, gloss, and minimum dry film thickness for painted finishes.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL:

A. General: Comply with manufacturer's written instructions.

B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

C. Utilities: Refer to CSI Division 22 for plumbing requirements and CSI Division 26 for electrical requirements.

D. Range Anti-tip Device: Install at each range according to manufacturer's written installation.

3.3 CLEANING AND PROTECTION:

A. Test each item of appliances to verify proper operation. Make necessary adjustments.

B. Verify that accessories required have been furnished and installed.

C. Remove packing material from appliances and leave units in clean condition, ready for operation.

END OF SECTION 113100

SECTION 122113 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Horizontal louver blinds with aluminum slats for all interior and exterior windows.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Samples for Initial Selection: For each type and color of horizontal louver blind indicated.

1. Include similar Samples of accessories involving color selection.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for each type of horizontal louver blind.

1.3 QUALITY ASSURANCE:

A. Source Limitations: Obtain horizontal louver blinds through one source from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Fire-Test-Response Characteristics: Provide horizontal louver blinds with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Flame-Resistance Ratings: Passes NFPA 701.

C. Product Standard: Provide horizontal louver blinds complying with WCMA A 100.1.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Deliver horizontal louver blinds in factory packages, marked with manufacturer and product name, fire-test-response characteristics, lead-free designation.

1.5 PROJECT CONDITIONS:

A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and dirty finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Engineer of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS:

A. Available Manufacturers: Subject to compliance with requirements, manufactures that offer products that may be incorporated into the Work include, but are not limited to, the following:

1. Hunter Douglas.
2. Levolor, a Newell Rubbermaid Company.
3. Springs Window Fashions Division, Inc.

B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radiused corners.

1. Width: 2 inches.

a. Spacing: Manufacturer's standard

2. Thickness: Not less than 0.008 inch.
3. Finish: One color.

a. Ionized Coating: Antistatic, dust-repellent, baked polyester finish.

b. Initial Color Selection: Silver Gray.

C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and end plugs and the following:

1. Capacity: One blind per headrail.
2. Integrated Headrail/Valance: Curved face.
3. Light-blocking lower back lip.

D. Bottom Rail: Formed-steel or extruded-aluminum tube, with plastic or metal capped ends top contoured to match crowned shape of slat; with enclosed ladders and tapes to prevent contact with sill.

E. Ladders: Evenly spaced to prevent long-term slat sag.

1. For Blinds with Nominal Slat Width 2 Inches or More: Braided string.

F. Lift Cords: Manufacturer's standard.

G. Tilt Control: Enclosed worm-gear mechanism**,** slip clutch or detachable wand preventing over-rotation, and linkage rod, and the following:

1. Tilt Operation: Manual with clear plastic wand.

2. Tilt: Full.

H. Lift Operation: Manual, cord lock; locks pull cord to stop blind at any position in ascending or descending travel.

I. Mounting: As indicated, permitting easy removal and replacement without damaging blind or adjacent surfaces and finishes; with spacers and shims required for blind placement and alignment indicated.

1. Provide intermediate support brackets if end support spacing exceeds spacing recommended by manufacturer for weight and size of blind.

2.2 HORIZONTAL LOUVER BLIND FABRICATION:

A. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.

B. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Blind Units Installed between (inside) Jambs: Width equal to 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch, less than jamb-to-jamb dimension of opening in which each blind is installed. Length equal to 1/4 inch, plus or minus 1/8 inch), less than head-to-sill dimension of opening in which each blind is installed.

C. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail, valance, and operating hardware, and for hardware position and blind mounting method indicated.

D. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.

E. Color-Coated Finish:

1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

F. Component Color: Provide rails, cords, ladders, and exposed-to-view metal, wood, and plastic matching or coordinating with slat color, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Install horizontal louver blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior slat edges in any position are not closer than 2 inches to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware if any.

B. Jamb Mounted: Install headrail flush with face of opening jamb and head.

3.3 ADJUSTING:

A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free of binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION:

A. Clean horizontal louver blind surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that horizontal louver blinds are without damage or deterioration at time of the issuance of the Certificate of Compliance.

C. Replace damaged horizontal louver blinds that cannot be repaired, in a manner approved by the Engineer.

END OF SECTION 122113

SECTION 123530 - CASEWORK

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Kitchen cabinets.
2. Media Room cabinets.
3. Cabinet hardware.
4. Countertop.

B. Related CSI Sections include the following:

1. Division 11 Section 113100, “Appliances” for appliances.
2. Division 22 Section 224216, “Commercial Lavatory and Sinks” for sinks.
3. Division 23 Section 233813, “Commercial-Kitchen Hoods” for exhaust hood.

1.2 DEFINITIONS:

A. Exposed Surfaces of Cabinets: Surfaces visible when doors and drawers are closed, including visible surfaces in open cabinets or behind glass doors.

B. Semi exposed Surfaces of Cabinets: Surfaces behind opaque doors or drawer fronts, including interior faces of doors and interiors and sides of drawers. Bottoms of wall cabinets are defined as "semi exposed."

C. Concealed Surfaces of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, bottoms of drawers, and ends of cabinets installed directly against and completely concealed by walls or other cabinets. Tops of wall cabinets and utility cabinets are defined as "concealed."

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following:

1. Cabinets.
2. Plastic-laminate countertops.
3. Cabinet hardware.
4. Adhesive.

C. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Composite wood manufacturer's product data for each composite wood product used indicating that the bonding agent contains no urea formaldehyde.
3. Adhesive manufacturer's product data for each adhesive used indicating that the adhesive contains no urea formaldehyde.

D. Shop Drawings: For cabinets and countertops. Include plans, elevations, details, and attachments to other work. Show materials, finishes, filler panels, hardware, edge and backsplash profiles, methods of joining countertops, and cutouts for plumbing fixtures.

E. Samples for Initial Selection: For each type of material exposed to view.

F. Samples for Verification:

1. Wood-veneered panels with transparent finish, 8 by 10 inches for each species.
2. Solid wood with transparent finish, 50 sq. in. for each species.
3. Solid wood trim with transparent finish, 8 inches long, for each species.
4. Plastic laminate for cabinet finish, 8 by 10 inches.
5. Plastic laminate for countertops, 8 by 10 inches.

G. Product Certificates: Signed by manufacturers of casework certifying that products furnished comply with requirements.

H. Maintenance Data: For kitchen casework to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE:

A. Source Limitations for Cabinets: Obtain cabinets through one source from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Quality Standards: Unless otherwise indicated, comply with the following standards:

1. Cabinets: KCMA A161.1.

a. KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semi exposed location of each unit and showing compliance with the above standard.

2. Plastic-Laminate Countertops: KCMA A161.2.

1.5 PROJECT CONDITIONS:

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Provide fillers and scribes to allow for trimming and fitting.

C. Field Measurements: Where casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.

1.6 COORDINATION:

A. Coordinate layout and installation of blocking and reinforcement in partitions for support of casework.

PART 2 - PRODUCTS

2.1 CABINET MATERIALS:

A. General:

1. Adhesives: Do not use adhesives that contain urea formaldehyde.
2. Hardwood Lumber: Kiln dried to 7 percent moisture content.
3. Softwood Lumber: Kiln dried to 10 percent moisture content.
4. Hardwood Plywood: HPVA HP-1, made with adhesive containing no urea formaldehyde.
5. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
6. Particleboard: Straw-based particleboard complying with requirements of ANSI A208.1, Grade M-2, except for density.
7. Hardboard: AHA A135.4, Class 1 Tempered.

B. Exposed Materials:

1. Exposed Wood Species: Red Oak.

a. Select materials for compatible color and grain. Do not use two adjacent exposed surfaces that are noticeably dissimilar in color, grain, figure, or natural character markings.
b. Staining and Finish: As selected by Designer from manufacturer's full range, no less than five options.

2. Solid Wood: Clear hardwood lumber of species indicated, free of defects.
3. Plywood: Hardwood plywood with face veneer of species indicated, with Grade A faces and Grade C backs of same species as faces.

a. Edge band exposed edges with minimum 1/8-inch-thick, solid-wood edging of same species as face veneer.

C. Semi exposed Materials: Unless otherwise indicated, provide the following:

1. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects. Same species as exposed surfaces or stained to be compatible with exposed surfaces.
2. Plywood: Hardwood plywood with Grade C faces and not less than Grade 3 backs of same species as faces. Face veneers of same species as exposed surfaces or stained to be compatible with exposed surfaces.
3. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

a. Provide material finished on both sides for shelves, dividers, drawer bodies, and other components with two semi exposed surfaces.
b. Colors: White.

D. Concealed Materials: Solid wood or plywood, of any hardwood or softwood species, with no defects affecting strength or utility; particleboard; medium-density fiberboard; or hardboard.

2.2 CABINET HARDWARE:

A. General: Manufacturer's standard units complying with BHMA A156.9, of type, size, style, material, and finish as selected by Architect from manufacturer's full range.

B. Pulls: Wire pulls.

C. Hinges: Semi concealed (wraparound) butt hinges for overlay doors.

D. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05011 or B05091.

2.3 COUNTERTOP MATERIALS:

A. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Formica Corp.
b. Lamin-Art.
c. Nevamar Company, LLC.
d. Panolam Industries International Incorporated.
e. Wilsonart International.

2. Grade: HGS.
3. Provide through-color plastic laminate.
4. Grade for Backer Sheet: BKL.
5. Colors, Textures, and Patterns: As selected by Designer from plastic-laminate manufacturer's full range.

B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, and touch sanded.

D. Adhesives: Do not use adhesives that contain urea formaldehyde.

E. Configuration: Provide countertops with the following front, cove (intersection of top with backsplash), backsplash, and endsplash style:

1. Front: Rolled.
2. Cove: Cove molding (one-piece postformed laminate supported at junction of top and backsplash by wood cove molding).
3. Backsplash: Curved or waterfall shape with scribe.
4. Endsplash: None.
5. Color: Earth Tones.

F. Plastic-Laminate Substrate: Particleboard not less than 3/4 inch thick.

1. For countertops at sinks and lavatories, use Grade M-2-Exterior-Glue particleboard or exterior-grade plywood.

G. Backer Sheet: Provide plastic-laminate backer sheet on underside of countertop substrate.

2.4 CABINETS:

A. Face Style: Flush overlay; door and drawer faces cover cabinet fronts with only enough space between faces for operating clearance.

B. Cabinet Style: Frameless.

C. Door: Solid-wood stiles and rails, 3/4 inch thick, with 1/4-inch- thick, veneer-faced plywood center panels.

D. Drawer Fronts and Apron: Solid-wood, 3/4 inch thick.

E. Face Frames: 5/8-inch-thick particleboard with plastic laminate on exposed and semi exposed surfaces.

F. Exposed Cabinet End Finish: Wood veneer.

G. Cabinet End Construction: 1/2-inch-thick plywood.

H. Cabinet Tops and Bottoms: 1/2-inch-thick particleboard or 3/8-inch-thick plywood, fully supported by and secured in rabbets in end panels, front frame, and back rail.

I. Wall-Hung-Unit Back Panels: 3/16-inch-thick plywood fastened to rear edge of end panels and to top and bottom rails.

J. Base-Unit Back Panels: 1/8-inch-thick hardboard fastened to rear edge of end panels and to top and bottom rails.

K. Drawers: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.
2. Subfronts, Backs, and Sides: 3/8-inch-thick particleboard.
3. Bottoms: 1/4-inch-thick particleboard.

L. Shelves: 5/8-inch-thick particleboard or 1/2-inch-thick plywood.

M. Joinery: Rabbet backs flush into end panels and secure with concealed mechanical fasteners. Connect tops and bottoms of wall cabinets and bottoms and stretchers of base cabinets to ends and dividers with mechanical fasteners. Rabbet tops, bottoms, and backs into end panels.

N. Factory Finishing: Finish cabinets at factory. Defer only final touchup until after installation.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install cabinets with no variations in flushness of adjoining surfaces; use concealed shims. Where cabinets abut other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match cabinet face.

B. Install cabinets without distortion so doors and drawers fit openings and are aligned. Complete installation of hardware and accessories as indicated.

C. Install cabinets and countertop level and plumb to a tolerance of 1/8 inch in 8 feet.

D. Fasten cabinets to adjacent units and to backing.

1. Fasten wall cabinets through back, near top and bottom, at ends and not less than 24 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.

E. Fasten plastic-laminate countertops by screwing through corner blocks of base units into underside of countertop. Form seams using splines to align adjacent surfaces, and secure with glue and concealed clamping devices designed for this purpose.

1. Provide cutouts for sinks and lavatories, including holes for faucets and accessories.
2. Countertop at kitchen sink shall be provided with the capability to be adjusted to meet accessibility requirements.

3.2 ADJUSTING AND CLEANING:

A. Adjust cabinets and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

B. Clean casework on exposed and semi exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION 123530

SECTION 132160 – INSTALLATION OF NEW FUEL FACILITY

PART 1 - GENERAL

1.1 SUMMARY:

A. The Contractor shall install three complete fuel facilities, except as otherwise noted, in conformity with the lines, grades, dimensions and details shown on the plans and as described herein.

B. Each component of the fuel facility gasoline tank and dispensing system shall be compatible with the dispensing of E85 Ethanol. Where model numbers are used herein, but are not compatible with E85 Ethanol, the appropriate E85 Ethanol compatible component shall be supplied at no additional cost to the Engineer.

C. The tank nipple arrangement described herein and shown on the plans is based upon the aboveground storage tank identified herein. "Or Equal" submissions will address the need for an alternative tank nipple arrangement, if necessary, that is acceptable to the Designer. Alternative tank nipple arrangements will also be at no additional cost to the Engineer.

D. Related CSI Sections include the following:

1. Division 13 Section 132180, "Tank Monitoring System" for aboveground and underground storage tank monitoring system.

1.2 DEFINITIONS:

A. AST: Aboveground storage tank.

B. CARB: California Air Resources Board

C. DEF: Diesel Exhaust Fluid.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Also include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: For storage tanks and pumps, include details of supports and anchors. Indicate all critical dimensions, locations of all nipples, and accessories, etc.

D. Quality Assurance Submittals:

1. Certification that tank test equipment conforms to State and Federal requirements and that the persons performing the tests are qualified on said test equipment.
2. Field quality control test reports.

E. Operation and Maintenance Data: For fuel facility equipment and accessories to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS. Include the following:

1. Interconnection as-built wiring diagrams with identified system components and devices for the entire fuel control center and fuel island.

F. Warranty: Special warranties specified in Part 1.7, "WARRANTY."

1.4 QUALITY ASSURANCE:

A. Electrical Installer Qualifications: An experienced electrician capable of wiring, installing, and troubleshooting all related portions of a fuel facility as specified in this Section.

B. Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 818 Article 1.20-1.05.24 subsection 2.

1. Meet with Engineer's representatives before any conduit or conductors are installed to develop a mutual understanding of the details and interconnections of the Fuel Management System, Tank Monitoring System, fuel dispensers, and submersible pumps. Ensure the participation of the Contractor, Electrical Installer, Fuel Management System manufacturers' authorized service representative, Tank Monitoring System manufacturers' authorized service representative, submersible pump manufacturers' authorized service representative, and other support personnel. Provide seven calendar days' advance notice of scheduled meeting time and location.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Lift tanks in accordance with manufacturer's instructions and with the proper equipment. Do not use chain or cables around tanks at any time. If tanks have to be

moved, set on smooth ground free of rocks and foreign objects. Do not drop or roll tanks. Do not allow tanks to be impacted.

B. Other Tank Materials: Store material in a clean dry area protected from damage. Materials may be stored outside only with the written approval of the Engineer.

1.6 COORDINATION:

A. A charge of $26,640 shall be included in the contract bid price for the filling of the gasoline, diesel, and DEF ASTs to 90% of the rated capacity with Automotive Unleaded Gasoline, Ultra Low Sulfur Vehicular Diesel, and Diesel Exhaust Fluid or as otherwise directed by the Engineer. All Contractors will include the above amount for gasoline, diesel, and DEF AST filling in the Contract Bid Price.

B. All bidders will include the above amount in Item No. 1600002A – Fuel Adjustment Cost along with costs for other fuels.

1.7 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace storage tanks that fail in materials or workmanship within specified warranty period.

1. Storage Tanks:

a. Failures include, but are not limited to, the following when used for storage of motor fuel at temperatures not exceeding 150 deg F:

1) Structural failures including cracking, breakup, and collapse.
2) Corrosion failure including external and internal corrosion of tanks.

b. Warranty Period: 30 years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS:

A. Black Steel Pipe: Schedule 40, conforming to ASTM A53 with malleable iron fittings conforming to ANSI B16.3.

B. Galvanized Steel Pipe: Schedule 40, conforming to ASTM A53 with zinc-coated malleable iron fittings conforming to ANSI B16.3.

2.2 JOINING MATERIALS:

A. Per manufacturer recommendations unless otherwise noted.

2.3 PROTECTED, STEEL, MOTOR FUEL AST:

A. Description: UL 142 and UL 2085; thermally insulated, fire-resistant and protected, double-wall, horizontal, steel tank; with primary- and secondary-containment walls and insulation and with interstitial space.

B. Construction: Concrete-Vaulted or Insulated Double-Wall.

1. Concrete-Vaulted: Fabricated with welded, carbon steel and insulation and encased in concrete; suitable for operation at atmospheric pressure and for storing motor fuel.

a. The tank shall consist of a primary steel tank covered by a minimum of ¼" thick extruded polystyrene foam insulation panels. The secondary containment shall consist of a 30 mil thick high-density polyethylene membrane enclosing the steel tank and insulation material. The primary steel tank and the secondary containment shall be encased in six inches of monolithic reinforced concrete, with minimum design strength of 5,000 psi at 28 days.
b. The concrete design shall include the following for long-term durability: air entrainment, water reducing admixture, and steel reinforcement. Concrete encasements with seams will not be approved. The protected and insulated tank systems shall contain no cold joints or heat sinks (heat transfer points). No steel or insulating material shall come in contact with the concrete or other corrosive material.

2. Insulated Double-Wall: Fabricated with welded, carbon steel and insulation; suitable for operation at atmospheric pressure and for storing motor fuel.

a. The tank shall consist of an inner steel tank, encased by lightweight thermal insulation material, and an outer steel wall. The outer steel wall shall be capable of providing a minimum 110% containment of the primary storage tank's content.
b. Steel outer wall of the tank shall be coated to prolong weather resistance and to further reduce maintenance needs. All external surfaces including the tank shall receive a commercial grit blast, epoxy primer coat, and finish coatings.
c. The tank's interstitial space shall include a porous, lightweight monolithic thermal insulation material. The thermal insulation material shall not be

exposed to weathering, shall be protected by the steel secondary containment outer wall, and shall allow liquid to migrate through the interstice to the monitoring point.

C. Protection: The AST's shall be suitable for operation at atmospheric pressure; fabricated to meet the following criteria:

1. Provide two (2) hour fire protection in accordance with UL 2085.
2. Vehicle Impact Resistance: Tanks shall be designed to have a low center of gravity that can withstand vehicle impact and tipping during earthquakes and other natural disasters.
3. Ballistic Resistance: Tanks shall withstand bullet resistance tests in compliance with UL 2085.
4. Lightning Protection: The protected and insulated AST systems shall have two (2) bolts for connecting grounding conductors for lightning protection. Grounding conductor and grounding rod materials and installation shall be in accordance with NFPA 780.

D. The primary steel tanks shall include an atmospheric vent and emergency venting in accordance with NFPA 30 Code requirements.

E. Support legs shall be monolithically cast with the concrete vault or welded to outer tank as a complete UL-listed unit.

2.4 DIESEL EXHAUST FLUID DISPENSING SYSTEM:

A. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. SBD KB2040 400 Gallon Fleet Mini-Bulk System as manufactured by KleerBlue, Inc. or an approved equal.

B. Description: 400 gallon capacity, island-oriented, turn-key system with tank and dispenser, pre-assembled, pre-wired and tested, capable of integration with ConnDOT Standard Automated Fuel Management System (FuelMaster) and Tank Monitoring System (Pneumercator TMS-3000).

C. Standard: CSA C.22.2 & UL 508

D. The complete DEF system shall include the following:

1. HDLPE 400 gallon single wall tank in double wall outer shell.
2. R-16 insulation on bottom, sides, and top
3. 200 watt redundant heating system.
4. Submersible pump.
5. Primary and secondary tank vents.
6. 2" Stainless steel fill adaptor and cap.
7. Overfill protection.
8. Anchor kit.

9. Cold weather resistant dispenser.
10. Dispenser:

    a. Stainless steel sides and door.
    b. 100:1 Pulse output to communicate with FMU.
    c. Cold weather resistant with insulation and dual 800 watt heaters.
    d. Spring rewind hose reel with 25 foot hose.
    e. Stainless steel components including filter, swivel, breakaway, and nozzle.

2.5 AST ACCESSORIES:

A. Threaded pipe connection nipples on top of tank for fill, vapor recovery, submersible pump, vent, in-tank probe, interstitial sensor, and gauging, in locations and of sizes indicated on the Plans.

B. (Gasoline and Diesel) 24" Manway Assembly for access to inside the tank with 8" Emergency Vent. The emergency vent relief system shall relieve the pressure of the primary tank if the tank pressure exceeds 1/2 psig.

C. Tank Fill Assembly: 7-gallon coated, UL listed spill containment. The assembly shall include a normally closed drain valve to release spilled product into the primary tank and a stick port for manual gauging.

D. Tank Charts: Provide (3) copies. Mount 1 copy in a glass frame secured to the wall with 4 screws adjacent to the Fuel Control Center, or as directed by the Engineer. Charts shall be calibrated to show tank capacity in gallons from feet and inches, graduated by eighths.

E. Gauge Stick: Wooden, manufacturer's recommended length, treated after graduating to prevent swelling and damage from fuel. Gauge stick shall be graduated in feet, inches, and eighths.

F. Stair Assembly: Tank manufacturer's standard galvanized steel stairway for access to the top of the tank. Stairs and railings shall comply with OSHA Standards.

G. Emergency Response Identification: Hazard sign that meets the requirements of NFPA 704. Hazard rating numerals shall be a minimum of 3 inches high. Sign shall be vinyl or aluminum, intended for outdoor use.

H. Safety Railings: Tank manufacturer's standard galvanized steel perimeter railings for fall protection on top of the tank. Railings shall comply with OSHA and CT DOT Safety Standards.

2.6 TANK INSTALLATION MATERIALS:

A. Grout: Non-shrink type.

B. Granular Fill: Refer to Form 818, Section 2.13 "Granular Fill" for material and construction methods required.

C. Concrete Pads: Comply with the requirements in CSI Division 03 Section 033000, "Cast-in-Place Concrete."

2.7 STORAGE TANK SPECIALTIES:

A. Submersible Pump:

1. Gasoline and Diesel: Construction type AG high capacity, ¾-HP, 208-230 volt, single phase, Model No. AGUMP75S1 with AGP75S1 manifold as manufactured by Red Jacket, or an approved equal, with model length sized to fit tank.

B. Overfill Prevention Valve Assembly:

1. Gasoline and Diesel: Suitable for installation in aboveground motor fuel storage tanks and compatible with E85 Ethanol, provide Model No. 61fSTOP-200M as manufactured by OPW, or an approved equal, which will stop the flow of liquid into the tank when product level reaches 95% of tank capacity.

a. Lower Drop Tube: Aluminum, compatible with overfill prevention valve, as manufactured by OPW, or an approved equal. Drop tube shall terminate 6-inches above the bottom of the tank, with the end of drop tube cut off at a 45-degree angle.

C. Fill Adaptor and Cap: 2-inch Tank Inlet Spout Adaptor Model No. 633AST with 2-inch locking dust cap, Model No. 634BK as manufactured by OPW, or an approved equal.

D. Vapor Recovery Adaptor and Cap (Gasoline): Threaded Adaptor, Model No. 323, and locking vapor adaptor cap, Model No. 323C, as manufactured by Morrison Bros., or an approved equal.

E. Stick Port Cap: Test well lockable cap and adaptor, 2" NPT.

F. Vent Cap:

1. Gasoline and E85 Ethanol: CARB Approved, pressure vacuum type, corrosion-resistant, internal wire screen designed to protect vent lines from water, debris, and insects, and normally closed poppet, Model No. 723V as manufactured by OPW, or an approved equal.
2. Diesel: Open atmospheric type, corrosion-resistant, internal wire screen designed to protect vent lines from water, debris, and insects, Model No. 23 as manufactured by OPW, or an approved equal.

G. Solenoid Valves with Thermal Pressure Relief: Two-way electrically operated, normally closed diaphragm valve to prevent accidental siphoning of fuel in case of a

leak or break in the fuel line, provide Model No. 821 with Model No. 82RV relief valve as manufactured by OPW, or an approved equal.

H. External Emergency Valve: Designed for installation at the outlet of an AST where product flow must be stopped in the event of a fire. UL listed, 2" NPT, ductile iron body, with 165 degree F. fusible link, Model No. 346 as manufactured by Morrison Bros., or an approved equal.

I. Ball Valves: Full Port Two-Way as manufactured by OPW, or an approved equal.

J. In-Tank Probe Cap and Adaptor: Bronze, side-sealing adaptor, side sealing cap (tapped), wire grommet to secure cables, Model No. 62M as manufactured by OPW, or an approved equal.

2.8 SOURCE QUALITY CONTROL:

A. Pressure test and inspect fuel storage tanks, after fabrication and before shipment, according to ASME and the following:

1. Horizontal, Concrete-Vaulted and Insulated, Steel ASTs: UL 142 and UL 2085.

B. Affix standards organization's code stamp.

2.9 FUEL DISPENSERS:

A. Dispensers:

1. Gasoline: Subject to compliance with requirements, single product dispensers shall be 3711SNR-AGLF1 as manufactured by Bennett, or an approved equal. Electronic-type, pedestal-mounted, standard capacity remote dispenser with lane-oriented nozzle boot, with electromechanical totalizer, suitable for dispensing a single product through 1 hose. Each component in the product path shall be compatible with dispensing E85 Ethanol. Cabinet shall be heavy gauge stainless steel including cabinet top, sides, base, and the hinged cabinet door panel shall be stainless steel.
2. High Flow Diesel: Subject to compliance with requirements, single product dispensers shall be 3711BMR-SGLF1 as manufactured by Bennett, or an approved equal. Electronic-type, pedestal-mounted, super high capacity remote dispenser with lane-oriented nozzle boot, with electromechanical totalizer, suitable for dispensing a single product through 1 hose. Cabinet shall be heavy gauge stainless steel including cabinet top, sides, base, and the hinged cabinet door panel shall be stainless steel.
3. Dual Flow Diesel: Subject to compliance with requirements, single product dispensers shall be 3712BMR-SGLF1 as manufactured by Bennett, or an approved equal. Electronic-type, pedestal-mounted, super high capacity remote dispenser with lane-oriented nozzle boots, with electromechanical totalizers,

suitable for dispensing a single product through 2 hoses. Cabinet shall be heavy gauge stainless steel including cabinet top, sides, base, and the hinged cabinet door panel shall be stainless steel.

B. Dispenser Product ID Panels: 22.5-inch wide by 2.64-inch high polycarbonate panels as manufactured by Gasoline Advertising Products, or an approved equal:

1. Diesel: Part #DG00-PID-DSL, color coded "Yellow."
2. Gasoline: Part #DG00-PID-UNL, color coded "Silver."

C. Dispenser Pedestal-Mount Kit: Manufacturer's low profile stainless steel dispenser platform for mounting dispenser with factory installed penetration fittings for product piping and electrical conduits.

D. Dispenser and FMU Island Forms: Prefabricated, stainless steel, 13-inches deep by the width and the length indicated on the Plans as manufactured by OPW, or an approved equal

E. Emergency Shear Valves:

1. Gasoline: Cast-iron body double-poppet-type, Model No. 10P-0152E85 and manufacturer standard mounting kit Model No. 10UBK-015 as manufactured by OPW, or an approved equal.
2. Diesel: Cast-iron body double-poppet-type, Model No. 10BFP-5726 and manufacturer standard mounting kit Model No. 10UBK-015 as manufactured by OPW, or an approved equal.

F. Filter and Filter Adapter: 1-inch spin-on filter with adapter, suitable for mounting within dispenser, as manufactured by Cim-Tek, or an approved equal:

1. Gasoline and Diesel: Model No. 400MB-10.
2. High Flow Diesel: Model No. 800BMG-10.

G. High hose retractors and static wires: Manufacturer standard with foot base and dispenser bracket.

H. Breakaway Hose Couplings:

1. Gasoline and Diesel: ¾-inch diameter single use breakaway coupling Model No. 66V-0492 as manufactured by OPW, or an approved equal.
2. High-Flow Diesel: 1-inch diameter single use breakaway coupling Model No. 66V-1300 as manufactured by OPW, or an approved equal.

I. Hose:

1. Black rubber, smooth bore, whip hose with stainless steel fittings. Swivel on one end, fixed on the other.

a. Hose Length from Dispenser to Breakaway Coupling: 17-feet. Swivel end at dispenser.
b. Hose Length from Breakaway Coupling to Nozzle: 8-inches. Swivel end at nozzle.
c. Diameter:

1) Gasoline, Diesel: ¾-inch.
2) High Flow Diesel: 1-inch.

J. Nozzles:

1. Gasoline and Diesel: Aluminum body and spout with 15/16" O.D., automatic-type, with full rubber hand insulator, Model No. 1A as manufactured by Husky Corporation, or an approved equal. Color-coded:

a. Gasoline: Silver.
b. Diesel: Yellow.

2. High-Flow Diesel: Aluminum body and spout with 1-3/16" O.D., automatic type, with full rubber hand insulator, Model No. 7H-0900, color-coded "Yellow" as manufactured by OPW, or an approved equal.

2.10 AUTOMATED FUEL MANAGEMENT SYSTEM:

A. Subject to compliance with requirements, the automated fuel management system shall be a FUELMASTER FMU3500 as manufactured by SYN-TECH Systems, Inc. (telephone number 1-800-888-9136). No "or equals" will be permitted. The automated fuel management system (hereinafter referred to as the system) is required to be fully compatible with all requirements of the ConnDOT Standard Automated Fuel Management System including, but not limited to, the following:

1. The ability to interface with the existing central location (Headend), located at 2800 Berlin Turnpike, Newington, CT.
2. The ability to accept the existing ConnDOT issued read/write keys.
3. The ability to initiate passive fueling transactions via RF transmission through SYN-TECH trademarked AIM2 vehicle mounted transceiver modules.
4. Interface with the tank monitoring system specified in CSI Division 13 Section 132180, "Tank Monitoring System."

B. The system shall include the following operational requirements:

1. Allow for unattended operation, seven days a week, 24 hours a day.
2. Turn fuel dispensers on and off.
3. Monitor and record up to 8 hoses dispensing simultaneously.
4. Lock out any unauthorized keys.
5. Limit the fueling product options for any key.

C. The system shall include the following components:

1. Fuel Management Unit (FMU): Flexible, modular design, to accept any future system upgrades, with the following features: key reader, LCD display to prompt vehicle operators, control keys for data input by vehicle operators, and surge suppressor. FMU shall be suitable for outdoor installation, being capable of resisting the affects or rain, snow, and blowing sand. FMU shall have an operating temperature range of -60 to 140° Fahrenheit. FMU shall have the ability to store all collected data for 3 months. Memory shall be removable, with the capability of being installed in an operational FMU for data recovery.
2. Dispenser-Mounted Pulse Transmitters: Individually set for any number of pulses from 1 to 1000 for each unit of measurement for every hose on every dispenser.
3. Communications Interface (Network Card): Provides the tank monitoring system pass-through capability so that the tank monitoring and fuel management reports are uploaded to the Headend via 10/100 Ethernet communications.
4. The FMU shall be equipped with AIM2 passive fueling system.

D. The following information shall be recorded by the system for each fueling transaction: user identification number, vehicle odometer/hourmeter, vehicle number, quantity of fuel dispensed, fuel site, date and time, hose number and product number, and key type.

2.11 FUEL CONTROL CENTER:

A. Panelboards: Comply with requirements in CSI Division 26 Section 260501, "Electrical Equipment for Fueling and Tanks".

B. Shunt Trip Device: Comply with requirements in CSI Division 26 Section 260501, "Electrical Equipment for Fueling and Tanks".

C. Fuel Island Signage: Locate as directed by Engineer.

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Red.
3. Background Color: White.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Suitable for mounting to masonry.
7. Label Content (Fuel Island): Label shall read as follows:

EMERGENCY ISLAND POWER SHUTOFF
AND PHONE LOCATED ON NEARBY PEDESTAL

PHONE WILL AUTOMATICALLY CALL 911
UPON ACTIVATION

STAY OUTSIDE OF VEHICLE DURING FUELING AND
IN SIGHT OF NOZZLE DURING DISPENSING

IN CASE OF FIRE OR SPILL USE
EMERGENCY STOP BUTTON ON NEARBY PEDESTAL

REPORT INCIDENT USING EMERGENCY PHONE

8. Label Content (Emergency Phone): Label shall read as follows:

EMERGENCY
POWER SHUTOFF
AND PHONE

D. Disconnect Switches: These disconnects shall switch the neutral conductor used for the control circuits in the dispensers. Comply with requirements in CSI Division 26 Section 262816, "Enclosed Switches and Circuit Breakers ".

E. Switches: Comply with requirements in CSI Division 26 Section 262726, "Wiring Devices".

F. Surface Mounted Communication Jack: RJ45 jack that fits in a single gang opening with one (1) receptacle, color orange, for Category 6.

G. Conduit: Comply with requirements in CSI Division 26 Section 260533, "Raceways and Boxes for Electrical Systems".

H. Wire: Comply with requirements in CSI Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables ".

I. Submersible Pump Control Boxes: Single-phase control box with contactor relay and dispenser hook isolation. Control boxes shall be Model No. 880-047-1, as manufactured by Red Jacket, or an approved equal.

J. Explosionproof Junction Boxes: Comply with requirements in CSI Division 26 Section 260533, "Raceways and Boxes for Electrical Systems".

K. Explosionproof Fittings: Comply with requirements in CSI Division 26 Section 260533, "Raceways and Boxes for Electrical Systems".

2.12 FIRE EXTINGUISHERS:

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by UL or FMG.

C. Fire Extinguishers: UL-rated 40-B:C.

1. Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Amerex Corporation.
b. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
c. Potter Roemer LLC.
d. Tyco Fire Protection Products

D. Fire-Protection Cabinet: Subject to compliance with requirements, provide Model No. FT-POLY-CAB as manufactured by Brooks Equipment Company, Inc., or approved equal.

1. Cabinet Type: Suitable for fire extinguisher.
2. Cabinet Construction: Weatherproof, suitable for outdoor installation.
3. Cabinet Material: Nonmetallic with UV inhibitors, or metallic with rust protection.
4. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on surface with no trim.
5. Door Style: Match cabinet material.
6. Door Glazing: Clear, transparent break-style glass or acylic.
7. Door Hardware: Manufacturer's standard door-operating hardware.
8. Accessories:
   a. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
   b. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
   c. Door Lock: Cylinder lock.
   d. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
      1) Identify fire extinguisher in fire-protection cabinet with the words "FIRE" or “FIRE EXTINGUISHER”.
         a) Location: Applied to cabinet sides and/or cabinet door.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL:

A. Refer to 818 Section 2.02, "Roadway Excavation, Formation of Embankment and Disposal of Surplus Material" and Section 2.05, "Trench Excavation" for excavating, trenching, and backfilling requirements.

B. Granular Fill shall be installed in accordance with Form 818 Article 2.13 beneath the concrete pads and apron as indicated on the plans. Protect buried items during compaction.

1. Concrete Pads: Provide a minimum of 6-inches of granular fill for concrete pads, compacted to support the concrete pad installation.

C. No backfilling over any underground piping or electrical connections may take place until the work is inspected by the Engineer and the authorities having jurisdiction. Failure to have work inspected will result in the Contractor uncovering work to allow for inspection.

3.2 OUTDOOR PIPING INSTALLATION:

A. Install metal pipes and tubes, fittings, and valves at piping connections to AST.

B. Support product piping with galvanized strut mast and pipe clamp mounted to the tank, tank pad, and metal beam rail posts. Support product piping at a minimum height of 6 inches above grade or as directed by Engineer and provide supports every 8-feet of horizontal run.

C. Install fittings for changes in direction in rigid pipe.

D. Install system components with pressure rating equal to or greater than system operating pressure.

3.3 VALVE INSTALLATION:

A. Install valves in accessible locations.

B. Protect valves from physical damage.

3.4 PIPING JOINT CONSTRUCTION:

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.5 PAINTING:

A. Paint exposed, exterior metal piping and piping specialties, except components with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel
d. Color: Gray

3.6 AST INSTALLATION:

A. Excavate as described herein and as shown on the Plans.

B. Set tank on concrete pad and anchor in accordance with manufacturer's instructions.

1. Install bearing pads as recommended by manufacturer.

C. Each component of the storage tank system shall be installed as shown on the Plans and in accordance with manufacturer recommendations. Additional installation requirements of the storage tank system are described in subsequent portions of this Section where applicable.

D. Connect piping.

E. Pressure Testing of Tank and Piping: Refer to Part 3.7, "Field Quality Control."

F. Supplying Fuel:

1. Refer to Part 1.6 "Coordination" for filling tanks. Supply appropriate fuel in accordance with specifications set forth in the most current State of Connecticut, Department of Administrative Services contract award for:

- 0035-066 - Gasoline, Automotive Unleaded
- 0035-042 - Diesel Fuel No. 1 & 2

2. To determine product suitability for application into State equipment, Contractor will be responsible for testing sample from tanker at time of delivery. Written results of testing will be provided within 7 days to the Engineer. Contracts with corresponding detailed specifications can be obtained by accessing the State of Connecticut, Department of Administrative Services' website at http://das.ct.gov/Purchase/Commodity.htm.
3. Prior to the issuance of the Certificate of Compliance, the Contractor shall fill all motor fuel tanks in accordance with the Contract requirements.
4. The Contractor shall provide to the Engineer 3 calendar days notice of its intent to fill tanks. Filling of tanks shall be witnessed by a representative of the Department.
5. DEF shall be supplied from one of the Department's approved vendors.

G. Apply Hazard Sign directly to tank in a visible location.

1. Hazard ratings for Diesel:

   a. Health (Blue): 0
   b. Fire (Red): 2
   c. Instability (Yellow): 0
   d. Special Hazard (White): None

2. Hazard ratings for Gasoline.

   a. Health (Blue): 1
   b. Fire (Red): 3
   c. Instability (Yellow): 0
   d. Special Hazard (White): None

3.7 FIELD QUALITY CONTROL:

A. Perform tests and inspections.

1. Tanks: Hydrostatic or compressed-air test pressures for horizontal, shop-fabricated, aboveground storage tanks: Isolate product piping from the tanks during testing. In-tank probes shall not be installed in the tanks during testing. Maintain the test pressure for one hour.

   a. Primary Tanks: Minimum 3 psig and maximum 5 psig.

2. Piping: Minimum hydrostatic or pneumatic test-pressures measured at highest point in system. Soap pipe fittings.

   a. Product Piping: Minimum 1.5 times the designed working pressure but not less than 50 psig nor more than the manufacturer's recommended pressure rating for minimum 3 hours.

b. Isolate storage tanks if test pressure in piping will cause pressure in storage tanks to exceed 10 psig.

B. Piping and equipment will be considered defective if it does not pass tests and inspections. Defective piping and equipment shall be repaired or replaced, and then retested.

C. DEF AST shall be tested and inspected in accordance with manufacturer's written instructions.

D. Prepare test and inspection reports.

3.8 FUEL DISPENSERS:

A. Bolt fuel dispensers into place and make all necessary piping connections. Secure shear valves to dispensers. Dispenser pedestal shall be anchored to the concrete with stainless steel anchors. High hose retractors shall be anchored to the concrete with stainless steel anchors.

3.9 AUTOMATED FUEL MANAGEMENT SYSTEM:

A. The automated fuel management system Installer shall provide a fully operational system including, but not limited to, the following:

1. Fuel Management Unit (FMU)
2. Dispenser-Mounted Pulse Transmitters and all necessary conduit
3. Communications Interface (Network Card): Provides the tank monitoring system pass-through capability so that the tank monitoring and fuel management reports are uploaded to the Headend via 10/100 Ethernet communications.
4. The following information shall be recorded by the system for each fueling transaction: user identification number, vehicle odometer/hourmeter, vehicle number, quantity of fuel dispensed, fuel site, date and time, hose number and product number, and key type.
5. Coordinate with ConnDOT Fuel Control for FMU configuration.
6. Coordinate network communications with ConnDOT network administrator.

B. Power Requirements for FMU: 120 volts, 60 Hz, from a separate, dedicated circuit from the Fuel Control Center Panel.

C. FMU shall be anchored to the concrete only with stainless steel hardware.

3.10 FUEL CONTROL CENTER:

A. Install all necessary conduit and wiring. A green bond wire shall be run in all conduit, terminating at Fuel Control Center Panel.

B. Conduit from the building to the base of each dispenser, submersible pump, FMU, level sensors, and island light fixture shall be provided with explosionproof fittings.

C. All E.Y. fittings shall be properly sealed. Leave close-up plugs hand tight after sealing to provide for inspection of these fittings.

D. Install junction boxes beneath dispensers to facilitate future maintenance.

E. Each submersible pump shall have a separate, dedicated circuit from Fuel Control Center Panel, wired through its own disconnect switch, control box, and dispenser hook isolation. The solenoid valve shall be powered and controlled from the submersible pump control box.

F. Install fuel island signage and salvaged "fuel system information" sign in a visible location as directed by Engineer.

3.11 FIRE EXTINGUISHERS:

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. General: Install fire extinguishers, mounting brackets, and fire-protection cabinet in locations indicated on the plans and in compliance with requirements of authorities having jurisdiction, 54 inches above finished grade to top of fire extinguisher.

D. Fire-Protection Cabinet: Fasten cabinets to surface, square and plumb.

1. Fasten mounting bracket to inside surface of fire-protection cabinets, square and plumb.

E. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

F. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

G. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

H. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

I. Replace fire-protection cabinet that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

3.12 DISPENSER ISLAND, APRON, AND PAD FOR TANKS:

A. Construct the concrete apron with bollards, and pads for the tanks, dispensers, and FMU as shown on the Plans. Concrete installation requirements are specified in CSI Division 03 Section 033000, "Cast-in-Place Concrete."

3.13 PIPING SCHEDULE:

A. Product Piping, Aboveground: 1-1/2-inch black steel pipe and pipe fittings.

B. Thermal Pressure Relief Piping: 1/2-inch black steel pipe and pipe fittings.

C. AST Pipe Risers: 4-inch galvanized steel pipe and fittings.

D. AST Vent Pipe and Fittings, Aboveground: 2-inch galvanized steel pipe and pipe fittings.

3.14 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 3 for additional information.

B. Engage a factory-authorized service representative for the fuel dispensers and automated fuel management system for a 4-hour on-site class to train the Owner's maintenance personnel on all operating, routine maintenance, and service procedures. Provide copies of all training materials to all in attendance.

END OF SECTION 132160

SECTION 132180 - TANK MONITORING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the complete tank monitoring system for aboveground and underground storage tanks and oil-water separator as indicated on the Plans.

B. Each component of the tank monitoring system shall be compatible with the dispensing of E85 Ethanol. Where model numbers are used herein, but are not compatible with E85 Ethanol, the appropriate E85 Ethanol compatible component shall be supplied at no additional cost to the Engineer.

C. The following contain requirements that relate to this Section:

1. Division 13 Section 132160, "Installation of New Fuel Facility."
2. Division 22 Section 221325, "Oil-Water Separator."
3. Division 26 Section 263213, "Engine Generators."

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include rated capacities of selected model clearly indicated, furnished specialties and accessories; wiring diagrams; and installation and start-up instructions.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.
2. Include sequence of operation for monitoring of oil-water separator.

1.3 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Installer Certifications as specified in Part 1.5, "Quality Assurance."
2. Field quality control test reports as specified in Part 3.3, "Field Quality Control."

1.4 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: Include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE:

A. The tank monitoring system manufacturer shall identify the approved distributor and repair staff located within a 50 mile radius of the Project Site, staffed with factory trained engineers fully capable of providing instruction, routine maintenance and 24 hour emergency repair service on all system components. Emergency repair service is to be available within a 24-hour period of time. Spare parts required for the system installed should be available within 2-4 calendar days.

B. The Tank Monitoring System Installer shall be certified to program and start-up the system.

C. The Tank Monitoring System Installer shall provide the engineering, installation, calibration, software programming and check-out necessary for a complete and fully operational tank monitoring system.

D. The Tank Monitoring System Installer shall have:

1. Adequate experience and verifiable history in the installation of tank monitoring systems matching the criteria defined in this Specification.
2. Proven expertise and experience in dealing with coordination of installing tank monitoring systems for municipal fueling facilities.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work are limited to the following:

1. Incon.
2. Pneumercator.
3. Veeder Root.

B. "Or Equal" manufacturers will not be considered for this project due to serviceability and training concerns.

2.2 GENERAL:

A. The tank monitoring system (hereinafter referred to as the system) shall be capable of monitoring 8 tanks, 4 pressurized lines, and 24 liquid sensors.

B. The system shall be capable of and suitable for monitoring Fuel Oil, Gasoline, Diesel Fuel, E85 Ethanol, Waste Oil, and Wastewater in aboveground and underground storage tanks and oil-water separators.

C. The system is required to be fully-compatible with the ConnDOT standard Automated Fuel Management System, including the ability to interface with the Headend. The Automated Fuel Management System is specified in CSI Division 13 Section 132160, "Installation of New Fuel Facility."

2.3 CONSOLE:

A. The console shall be microprocessor-based, of a flexible and modular design so as to accept future system upgrades, and equipped with the following features:

1. All necessary electronics and hardware to continuously accept, process, display, print, and store all probe and sensor data, reporting not only operating conditions, but also system malfunctions or failures contained within a single secured enclosure.
2. Front panel display for on-site viewing of all inventory, leak detection, and alarm information.
3. Front panel annunciator to annunciate alarm or system error conditions. Acknowledgment via front panel control keys shall be programmable to silence alarm horn for all previous conditions.
4. Front panel control keys for on-site control of the system.
5. A printer, of minimum 24 column width, shall provide hard copy reports for documentation of inventory, leak detection, alarm information, etc. Hard copy reports shall exit from the front panel.
6. A back-up battery and/or non-volatile memory shall maintain all configuration data in the case of a power outage. The system's memory shall be capable of storing the most recent inventory, leak detection, and alarm information.

B. The console shall consist of, but not be limited to, 3 compartments to separate intrinsically safe wiring and devices, high power wiring and devices, and communications wiring and devices.

1. Intrinsically Safe Wiring and Devices. The system shall have the ability to accept 8 in-tank magnetostrictive probes, 4 line leak detectors, and 24 liquid sensors.

   a. Console shall be UL-listed as intrinsically safe.
   b. Sensor input electronics shall include support for supervised wiring between the console and the sensor to identify short or open-circuited wiring.
   c. All probe and leak sensor inputs shall be protected against voltage spikes, such as "near hit" lightning activity.

2. High Power Wiring and Devices. The system shall have the ability via relays, controllers, etc., to actuate external audible and visual alarm devices, monitor the

activity of the submersible pumps and valves, etc. Relays shall be UL-listed devices having the following capabilities and features:

a. Relays shall be individually programmable via the control keys or the communications interfaces to trigger on any combination of events, including, but not limited to, leak, setpoint, water, theft, or contact closure input.
b. Relays shall be individually programmable for, or have connections for, normally energized/de-energized operation.
c. Relays shall be individually programmable to enable or disable front panel control key acknowledgment. If enabled, acknowledgment shall restore relay to its normal state.
d. The system shall allow the programmed activation of a second relay for any event listed above. This feature shall provide isolated control and signaling outputs.
e. Contact closure inputs shall be individually programmable for normally open/closed operation.
f. Contact closure inputs shall be individually programmable as an acknowledge or gating function to any relay, to trigger an alarm condition, and for pump override control applications.

3. Communications Wiring and Devices. The system shall have a minimum of 4 communications ports with the following capabilities:

a. The ability to communicate with locally attached electronic devices (Automated Fuel Management System and printer) through RS-232 ports.
b. The ability to communicate with networked electronic devices (Headend) through a factory installed network interface card. An internal network card shall be installed within each console.

2.4 IN-TANK PROBES:

A. The probes shall be magnetostrictive type suitable for leak detection and inventory management in both underground and aboveground storage tanks. Unless otherwise noted, probes shall include 2 floats (product and water), and shall also include a minimum of 5 temperature sensors along its length to allow product temperature averaging.

1. Temperature measurement accuracy of +/- 0.5°.
2. Level measurement accuracy of +/- .0005-inch.

B. The probes shall be gasoline, ethanol, benzene, and oil-resistant. The probes shall be UL-listed as intrinsically safe and shall utilize digital or time-based transmission techniques for high noise immunity and fault detection.

C. Leak Detection: Capable of manually or automatically performing a static tank tightness test to an accuracy of 0.1-gph, with a 99% probability of detection [P(D)] and a 1% probability of false alarm [P(FA)].

1. System shall be third-party certified to be in accordance with EPA standards for 0.1-gph annual tightness test and for 0.2-gph monthly monitoring.

D. The probes shall be capable of continuously gauging the water level from within 0.75-inch off of the bottom of the tank to a depth of at least 10-inches for riser pipe installations.

E. For oil-water separator applications, the probes shall be capable of continuously gauging the product and water levels from within 3-inches off the bottom of the tank. The system shall automatically calculate and output the volume (gallons) and level (inches) of product and of water in the oil-water separator.

F. The probes shall be supplied with the manufacturer's standard probe installation kits and wiring.

2.5 INTERSTITIAL SENSORS:

A. Wet Monitoring:

1. The hydrostatic sensors shall perform automatic, continuous leak sensing by monitoring the liquid level in the reservoir of a brine-filled interstitial space (annulus) of double-wall tanks, to detect a breach in the inner or outer shell. Single float sensors shall include a float and reed switch assembly. The contacts shall be normally closed dry contacts. Sensors shall be wired as discriminating type with individual alarms for high brine and low brine levels.
2. The sensors shall be unaffected by hydrocarbon vapors, and shall be easily installed and removed without damage. Sensors shall be field replaceable, reusable, and testable for regulatory purposes.
3. The sensors shall be supplied with a lockable, watertight riser cap to prevent accidental spills into the tank reservoir. The cap shall be equipped with a vent tube to vent air out of the reservoir area and prevent liquids from entering into the reservoir.
4. The sensors shall be supplied with the manufacturer's standard sensor installation kits and wiring.

B. Dry Monitoring:

1. The sensors shall perform automatic, continuous leak sensing by monitoring the dry interstitial space (annulus) of double wall tanks. Sensors shall be a non-discriminating type, sensing only wet or dry conditions.

2. The sensors shall be unaffected by hydrocarbon vapors, and shall be easily installed and removed without damage. Sensors shall be field replaceable, reusable, and testable for regulatory purposes.
3. The sensors shall be supplied with the manufacturer's standard sensor installation kits and wiring.

2.6 TANK OVERFILL ALARM:

A. Remote external audible and visual overfill alarm annunciator shall be housed in a weatherproof enclosure. The overfill alarm shall activate if a tank product level reaches the overfill alarm setpoint of 90% capacity. Provide model no. RA100 as manufactured by Pneumercator or an approved equal.

B. Remote alarm acknowledge unit shall be housed in a weatherproof enclosure. Acknowledge unit shall silence audible and visual overfill alarms.

2.7 SOFTWARE:

A. Network Communications for Remote Alarming/Reporting.

1. The manufacturer shall provide its communications/database software package and license (Headend) to poll remote tank monitoring sites from a total of five (5) locations, including the central location (2800 Berlin Turnpike, Newington, CT), via a network connection.
2. The Headend operator shall connect to remote sites by selecting the user-definable name associated with the site. Manual dialing is not acceptable.
3. The Headend operator shall be able to connect to the system and gain access to the full control, reporting, troubleshooting, and system modification capabilities described in this specification.
4. The Headend shall provide a communications mode, in which it can automatically and continuously poll locations that have been designated for data retrieval, and store data in a standard database format.
5. The system shall have the ability to automatically upload all alarms, reports, logs, and other features as described in this specification. The software package shall provide the ability to program the system from remote locations.
6. In the event that the system is unable to connect with the Headend, it shall continue to attempt communication on a predetermined interval until communication is successful.
7. The stored data shall be easily transferable to other software packages, such as spreadsheets, database packages, etc., for data manipulation.

B. Reports and Logs. The following reports and logs shall be provided for each tank and oil-water separator as indicated on the Plans:

1. Environmental Compliance Reports. The system shall have the ability to capture the following environmental compliance reports, as well as to provide hard copies of these reports at the console.

    a. In-Tank Warnings and Alarms.
    b. In-Tank Tightness Test Results.
    c. Liquid Sensor Warnings and Alarms.
    d. System Hardware and Software Errors.
    e. System Status Messages.
    f. Normally-closed Sensor warning and alarm conditions.
    g. External input messages.

2. The system shall also generate hard copy reports at the console for system errors, system clock and calendar, and system setup and configuration data.

C. Reports and Logs. The following reports and logs shall be provided for each gasoline tank, diesel fuel tank, and DEF tank and as indicated on the Plans.

1. Inventory Management Reports shall be generated for each tank either automatically a minimum of three times per day (programmable) or manually. In addition to the system capturing this data, hard copies of the reports will be generated at the console. Inventory Reports shall include the tank identification, product name, time and date, product level and volume, water level and volume, product temperature, gross volume, temperature compensated net volume, percent capacity, 90% ullage, and last in-tank leak test result.
2. Product Delivery Reports shall be generated for each tank automatically after a delivery to the tank is complete. In addition to the system capturing this data, hard copies of the report will be generated at the console. Fuel Delivery Reports shall include the tank identification, product name, time and date, starting and ending product levels and volumes, starting and ending product temperatures, and the net product volume increase.
3. Product Order Reports shall be manually generated for each tank. In addition to the system capturing this data, hard copies of the reports will be generated at the console. Fuel Order Report shall include the average daily product usage calculated from the last delivery, the total and usable inventory, the remaining product supply in days, and the maximum order amount (90% ullage) at the time of report generation.
4. Water Removal Report shall be generated for each tank automatically upon the removal of water from each tank. In addition to the system capturing this data, hard copies of the reports will be generated at the console. Water Removal Reports shall include the tank identification, product name, time and date; and starting and ending product volumes, water volumes, gross volume, percent capacities, and 90% ullage.

D. Reports and Logs. The following reports and logs shall be provided for each oil-water separator as indicated on the Plans.

1. Inventory Management Reports shall be generated for each tank either automatically a minimum of three times per day (programmable) or manually. In addition to the system capturing this data, hard copies of the reports will be generated at the console. Inventory Reports shall include the tank identification, product name, time and date, the last in-tank leak test result, product level and volume, and water level and volume.
2. Water Removal Report shall be generated for each oil-water separator automatically upon the removal of water from each tank. In addition to the system capturing this data, hard copies of the reports will be generated at the console. Water Removal Reports shall include the tank identification, product name, time and date; and starting and ending product volumes, water volumes, gross volume, percent capacities, and 90% ullage.

E. Alarms.

1. The system shall provide audible and visual indication of all system, in-tank leak (3.0-gph, 0.2-gph, and 0.1-gph failures), product line leak (3.0-gph, 0.2-gph, and 0.1-gph failures), and external sensor (product, water, sensor out) alarm conditions. The system shall also capture this data, and hard copies will be generated.
2. The system shall provide the operator the ability to disable the audible portion of an alarm. The visual portion of an alarm shall not be disabled until the alarm condition has been corrected.
3. The system alarms include:

    a. High High Limit (Overfill): 95% of tank volume programmed in inches.
    b. High Limit: 90% of tank volume programmed in inches.
    c. Low Inventory Limit: 25% of tank volume programmed in inches.
    d. High Water Limit: Alarm at 2.0 inches.
    e. Temperature.
    f. Theft.
    g. Delivery needed alarm.
    h. Periodic warning and alarm.
    i. Annual warning and alarm.
    j. Non-IS contact closure input.
    k. IS (liquid) sensor input.
    l. System error.
    m. Power recovery.
    n. Leak Test Failed.
    o. High Level Product Alarm (Oil-Water Separator): 20% of static fluid height programmed in inches.
    p. Low Level Water Alarm (Oil-Water Separator): When water level drops below 50% of tank capacity programmed in inches.
    q. High Brine Level and Low Brine Level (Oil-Water Separator).

4. The product limit alarms identified in subpart a, b, and c in Part 3 above shall be programmable in units of volume, percent volume, or level.

5. The operator shall have complete programming control to determine which alarm conditions, if any, shall control pumps, valves, or any other devices. Unless the system is set up to shut part of the system down on alarm, system shall remain operational during all alarm conditions.

F. Diagnostics and Troubleshooting.

1. The system shall provide the manufacturer's standard diagnostic and troubleshooting capabilities to facilitate field service. These capabilities shall include, but are not limited to, the following:

   a. Identifying the location of the malfunction, whether in the field or console.
   b. The system shall be capable of detecting and reporting corruption of configuration and set-up data. Affected system function(s) shall be disabled until corruption is corrected.
   c. The system shall be capable of limiting the range of selections on input to only "acceptable" values, or the system shall be capable of scanning operator-entered configuration and set-up data to check for "acceptable" values. Values that result in improper calculations or required entries that have not been defined by the operator shall generate a warning report, and shall disable the affected system function(s).
   d. The system shall be capable of detecting and reporting a power-up sequence, including power loss and recovery dates and times.
   e. The system shall be capable of ensuring the integrity of its hardware and software.
   f. Supervised wiring between the console and the interstitial sensors to identify short or open circuited wiring. System shall identify fault to the failed sensor.
   g. Supervised wiring between the console and the in-tank probes to detect a fault, either as failed hardware or as a result of faulty wiring. System shall identify fault to the tank.

2. The system shall generate hard copy reports of the diagnostic information, including the alarm history and alarm status at the console.

2.8 RELATED ELECTRICAL WORK:

A. Conduit: Comply with requirements in CSI Division 26 Section 260533, "Raceway and Boxes for Electrical Systems".

B. Explosionproof Fittings: Comply with requirements in CSI Division 26 Section 260533, "Raceway and Boxes for Electrical Systems".

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions under which the tank monitoring system is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the Tank Monitoring Installer.

3.2 INSTALLATION REQUIREMENTS:

A. All probe and leak sensor inputs shall be protected against damage from short circuit conditions due to inadvertent field wiring errors.

B. In-tank Probes.

1. Probes, probe installation kits, and wiring shall be installed according to manufacturer-supplied installation manuals and plans.
2. Probe assemblies for monitoring product and water levels are required for all double-wall tanks as indicated on the Plans.
3. Probe assemblies in underground storage tanks shall top-mount from a 4-inch diameter probe riser pipe. Riser installation is not work of this Section; risers shall be installed by the applicable CSI Section and as indicated on the Plans.
4. Probe leader cables to connect inside watertight junction box, sealed off with an explosion proof fitting, for connection to console.

C. Interstitial Sensors.

1. Sensors and wiring shall be installed according to manufacturer-supplied installation manuals and plans.
2. Sensors for monitoring the interstitial spaces are required for all double-wall underground and aboveground storage tanks as indicated on the Plans.
3. Sensor Assemblies:

   a. Underground Storage Tanks: Top-mount in a 4-inch diameter sensor riser pipe installed in the annulus of the tank. Riser installation is not work of this Section; risers shall be installed by the applicable CSI Section and as indicated on the Plans.
   b. Aboveground Storage Tanks: Top-mount in factory installed 2” nipple through monitor pipe/leak detector tube.

4. Sensor leader cables to connect inside watertight junction box, sealed off with an explosion proof fitting, for connection to console.

D. Tank Overfill Alarm:

1. Remote alarm annunciator and acknowledge unit wiring shall be installed according to manufacturer-supplied installation manuals.

2. The alarm light shall be visible and the alarm horn shall be audible within the fuel tank filling area.
3. The acknowledge unit shall be accessible to the tank filling attendant.
4. Remote alarm annunciator and acknowledge unit shall be mounted near the tank filling sites for the gasoline and diesel fuel tanks and for the fuel oil tank as indicated on the Plans.

E. The wall-mounted console with printer shall be located as shown on the Plans.

1. Console shall be mounted and wired according to manufacturer-supplied installation manuals, with all intrinsically safe field wiring enclosed in dedicated conduit and separate from all other wiring. The system's high voltage wiring may share existing conduit with other high voltage devices in accordance with applicable guidelines published in the NEC.
2. Console power requirements: 120-volts, 60-Hz, from a separate, dedicated circuit from the Fuel Control Center panel.

F. Related Electrical Work: Install conduit. Seal E.Y. fittings. Leave close-up plugs hand tight after sealing to provide for inspection of these fittings.

3.3 FIELD QUALITY CONTROL:

A. Engage a factory-authorized service representative to inspect and test the system and to perform start-up service. Power shall not be applied to the system prior to start-up.

B. Perform all necessary testing and run diagnostic tests to ensure proper operation. Test equipment as recommended by manufacturer. Generate all software and enter all database information necessary to perform the sequence of control and specified software routines.

1. An acceptance test shall be performed in the presence of the Engineer.

C. The manufacturer shall provide a written certification of installation, start-up, and calibration of the complete system.

D. The manufacturer shall supply third-party documentation for all products certifying that the performance meets or exceeds EPA requirements.

3.4 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative for an 8-hour on-site class to train Owner's maintenance personnel on all installation, programming, troubleshooting, operating, routine maintenance, and service procedures.

END OF SECTION 132180

SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes Metal Building Systems that consist of integrated sets of mutually dependent components including structural framing, anchorage system into the sub-structure, roof panels, wall panels, doors, and accessories.

B. Related CSI Sections include the following:

1. Division 03 Section 033000, "Cast-in-Place Concrete" for concrete foundations, knee walls, slab-on-grade, and anchor bolts installation.
2. Division 05 Section 051200, "Structural Steel Framing."
3. Division 07 Section 071900, "Water Repellents."
4. Division 08 Section 081113, "Hollow Metal Door & Frame."
5. Division 08 Section 083613, "Sectional Doors."
6. Division 08 Section 087100, "Door Hardware."
7. Division 09 Section 099113, "Exterior Painting."
8. Division 09 Section 009123, "Interior Painting."

1.2 DEFINITIONS:

A. Bay: Dimension between main frames measured normal to frame (at centerline of frame) for interior bays, and dimension from centerline of first interior main frame measured normal to side wall (outside face of side-wall girt) for side bays.

B. Building Length: Dimension of the building measured parallel to main framing from side wall to side wall (outside face of girt to outside face of girt).

C. Building Width: Dimension of the building measured perpendicular from end wall to end wall (outside face of girt to outside face of girt).

D. Clear Span: Distance between supports of beams, girders, or trusses (measured from lowest level of connecting area of a column and a rafter frame or knee).

E. Eave Height: Vertical dimension from finished floor to eave (the line along the side wall formed by intersection of the planes of the roof and wall).

F. Clear Height under Structure: Vertical dimension from finished floor to lowest point of any part of primary or secondary structure, not including crane supports, located within clear span.

G. Terminology Standard: Refer to MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

1.3 SYSTEM DESCRIPTION:

A. Provide a complete, integrated set of metal building system mutually dependent components and assemblies that form a building system capable of withstanding gravity and lateral loads, movements induced by changes in temperature and exposure to weather, without failure or infiltration of water into the building interior. Design all structural components based on the latest edition of the International Building Code (IBC) as supplemented by the State of Connecticut Building Code. Include primary and secondary framing, metal roof panels, metal wall panels, and accessories complying with the general requirement indicated below:

1. Provide a metal building system of length, width and height as dimensioned on the plans, and of roof slopes and spans indicated.

1.4 SYSTEM PERFORMANCE REQUIREMENTS:

A. Structural Performance: Provide a metal building system, capable of withstanding the stresses induced by the following loads, within the limits and conditions indicated:

1. Design a metal building system according to the procedures and requirements in MBMA "Metal Building Systems Manual", ASCE 7-02 "Minimum Design Loads for Buildings and Other Structures" and the 2005 Connecticut Building Code.
2. Live Loads: Vertical loads induced by the building occupancy indicated. For roof live loads, include the loads induced by maintenance workers, materials, equipments and permanent fixtures.
3. Roof Snow Loads: Vertical loads induced by the weight of snow, as determined by a 10-year, mean-recurrence-interval ground snow load at the Project Site. Include the effects of unbalanced and drift loads.
4. Wind Loads: Horizontal loads induced by wind at the Project Site. In addition, comply with requirements specified in the FM Global Property Loss Prevention Data Sheet 1-28 Wind Design.
5. Collateral Loads: Additional dead loads other than the gross weight of the metal building systems, to account for permanent fixtures that are to be attached to the building system, such as sprinklers, mechanical and electrical systems and ceiling.
6. Load Combinations: Design the metal building systems to withstand the most critical effects of load factors and load combinations as required by latest MBMA "Metal Building Systems Manual", ASCE 7-02 "Minimum Design Loads for Buildings and Other Structures" and the 2003 International Building Code.

7. Deflection Limits: Engineer assemblies to withstand design loads with deflections no greater than the following:

    a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
    b. Girts: Horizontal deflection of 1/240 of the span.
    c. Metal Roof Panels: Vertical deflection of 1/240 of the span.
    d. Metal Wall Panels: Horizontal deflection of 1/240 of the span.

8. Design secondary framing systems to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.
9. Provide metal panel assemblies capable of withstanding the effects of loads and stresses indicated, based on testing according to ASTM E1592.
10. Seismic Performance: Design metal building systems to withstand the effects of earthquake motions determined according to ASCE 7-02 "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads", and the 2005 Connecticut Building Code.
11. FM Global: Design the roof system to FM Global Data Sheets 1-28 and 1-29.
12. FM Global: Design the roof framing per FM Global Data Sheet 1-54 Roof Loads for New Construction, and include additional provisions to secure the roof perimeter and corners in accordance with FM Global Data Sheet 1-31 Metal Roof System.
13. FM Global: Design the roof framing to withstand calculated wind forces in the field of 60 pounds per square foot (psf) 90 pounds per square foot (psf) at the perimeter and 120 pounds per square foot (psf) building corners.

B. Thermal Movements: Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

    1. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

C. Thermal Performance: Provide insulated metal panel assemblies with the following maximum U-factors and minimum R-values for opaque elements when tested according to ASTM C1363 or ASTM C518:

    1. Metal Roof Panel Assemblies:

        a. R-Value: 30.0.

    2. Metal Wall Panel Assemblies:

        a. R-Value: 19.0.

3. Floor Assembly:

   a. R-Value: 7.0.

D. Air Infiltration for Metal Roof Panels: Air leakage through assembly of not more than 0.006 cfm/sq. ft. of roof area when tested according to ASTM E1680 at negative test-pressure difference of 12.0 lbf/sq. ft.

E. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E1646 at test-pressure difference of 12.0 lbf/sq. ft.

F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for Class 90.

G. FM Global: Provide approved Class 1 panel roof as per FMRC 4471. Provide an FM Approved roof assembly and FM Approved insulated metal panel siding.

1.5 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of the following metal building system components:

1. Structural-framing system, including the post anchorage system into the sub-structure.
2. Metal roof panels.
3. Metal wall panels and metal liner panels.
4. Insulation and vapor retarders
5. Flashing and trim; gutters and downspouts.
6. Other accessories.

C. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with required loads and provide structural analysis data signed and sealed by the Professional Engineer responsible for their preparation.
2. Anchor-Bolt Plans: Submit anchor-bolt plans, signed and sealed by the Professional Engineer responsible for their preparation, before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.
3. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing including provisions for openings, signed and sealed by the Professional Engineer responsible for their preparation. Indicate welds and

bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.

4. Metal Roof and Wall Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory and field-assembled work, show locations of exposed fasteners.

    a. Show roof-mounted items including equipment supports, pipe supports and penetrations, lighting fixtures, snow guards, and items mounted on roof curbs.
    b. Show wall-mounted items including doors, and lighting fixtures.

5. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:8).

    a. Flashing and trim.
    b. Gutters.
    c. Downspouts.

D. Product Samples for Initial Selection: To be provided for building components with factory-applied color finish.

E. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Product Certificates: For each type of metal building system, signed by the product Manufacturer.

    a. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

        1) Name and location of Project.
        2) Order number.
        3) Name of Manufacturer.
        4) Name of Contractor.
        5) Building dimensions including width, length, height, and roof slope.
        6) Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
        7) Governing Building Code and year of edition.
        8) Design Loads and Parameters: Include dead loads, roof live loads, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration.

9) Load Combinations: Indicate that all components of the building systems were designed for all applicable load combinations in compliance with the governing building codes.
10) Building-Use Category: Indicate the category of building use and its effect on load importance factors.
11) AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer.

3. Welding certificates.
4. Erector Certificate: Signed by the Manufacturer certifying that the Erector complies with requirements.
5. Manufacturer Certificate: Signed by Manufacturer certifying that products comply with requirements.
6. Qualification Data: For Erector, Manufacturer, Professional Engineer, Professional Land Surveyor and Testing Agency.
7. Material Test Reports: Signed by Manufacturers certifying that the following products comply with requirements:

   a. Structural steel including chemical and physical properties.
   b. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   c. Tension-control, high-strength bolt-nut-washer assemblies.
   d. Shop primers.
   e. Non-shrink grout.

8. Source Quality-Control test reports.
9. Field Quality-Control test reports.
10. Product Test Reports: Based on evaluation of comprehensive tests performed by the Manufacturer and witnessed by a qualified testing agency, for insulation and vapor retarders. Include reports for thermal resistance, fire-test-response characteristics, water vapor transmission, and water absorption.

F. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract. Have the surveyor who performed the surveys certify their accuracy.

G. Warranties: Special warranties specified in Part 1.10, “Warranty.”

1.6 QUALITY ASSURANCE:

A. Erector Qualifications: An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to the Metal Building System manufacturer.

B. Manufacturer Qualifications:

1. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility.

C. Engineering Responsibility: Preparation of shop drawings, details and comprehensive engineering analysis shall be done by a Professional Engineer licensed in the State of Connecticut.

D. Land Surveyor Qualifications: A Professional Land Surveyor who is legally qualified to practice in the State of Connecticut and who is experienced in providing surveying services of the kind indicated.

E. Testing Agency Qualifications: An independent agency qualified according to ASTM E329 for testing indicated, as documented according to ASTM E548.

F. Source Limitations: Obtain primary metal building system components, including structural framing and metal panel assemblies, through one source from a single manufacturer.

G. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

H. Structural Steel: Comply with AISC "Specification for Structural Steel Buildings--Allowable Stress Design, Plastic Design," or AISC "Load and Resistance Factor Design Specification for Structural Steel Buildings," for design requirements and allowable stresses.

I. Cold-Formed Steel: Comply with AISI "Specification for the Design of Cold-Formed Steel Structural Members," or AISI "Load and Resistance Factor Design Specification for Steel Structural Members," for design requirements and allowable stresses.

J. Surface-Burning Characteristics: Provide field-insulated metal panels having thermal insulation and vapor-retarder-facing materials with the following surface-burning characteristics as determined by testing identical products per ASTM E84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Spread Index: 25 or less, unless otherwise indicated.
2. Smoke-Developed Index: 450 or less, unless otherwise indicated.

K. Pre-Erection Meeting: Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 818 Article 1.20-1.05.24 subsection 2. Review methods and procedures related to metal building systems including, but not limited to, the following:

1. Inspect and discuss condition of foundations and other preparatory work performed by other trades.
2. Review structural load limitations.

3. Review and finalize construction schedule and verify availability of materials, Erector's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review required testing, inspecting, and certifying procedures.
5. Review weather and forecasted weather conditions and procedures for unfavorable conditions.

L. Pre-Installation Roof Assembly Meeting: Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 818 Article 1.20-1.05.24 subsection 2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:

1. Examine condition of purlins and rafters for compliance with requirements, including flatness and attachment to structural members.
2. Review structural limitations of purlins and rafters during and after roofing.
3. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
4. Review temporary protection requirements for metal roof panel assembly during and after installation.
5. Review roof observation and repair procedures after metal roof panel installation.

M. Pre-Installation Wall Assembly Meeting: Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 818 Article 1.20-1.05.24 subsection 2. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:

1. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
2. Review structural limitations of girts and columns during and after wall panel installation.
3. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
4. Review temporary protection requirements for metal wall panel assembly during and after installation.
5. Review wall observation and repair procedures after metal wall panel installation.

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Deliver components, sheets, panels, and other manufactured items in a manner that they would not be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner that would prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness and with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.8 PROJECT CONDITIONS:

A. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to Manufacturer's written instructions and warranty requirements.

B. Field Measurements:

1. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.
2. Established Dimensions for Metal Panels: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.9 COORDINATION:

A. Coordinate the size and location of concrete foundations and pilasters and the casting of anchor bolt inserts into foundation walls, footings and pilasters.

B. Coordinate the installation of roof penetrations and other appurtenant items.

C. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leak-proof, secure, and non-corrosive installation.

1.10 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which the Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

    a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
    b. Chalking in excess of a No.8 rating when tested according to ASTM D4214.
    c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from the issuance of the Certificate of Compliance.

C. Special Weather-tightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which the Manufacturer agrees to repair or replace standing-seam, metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Basis of Design: Butler Manufacturing Company.

B. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work, include but are not limited to, the following:

1. Butler Manufacturing Company.
2. Ceco Building Systems; Division of Robertson-Ceco Corporation.
3. Star Building Systems; Division of Robertson-Ceco Corporation.
4. Steelox Systems Inc.
5. VP Buildings, Inc.; a United Dominion Company.

2.2 STRUCTURAL-FRAMING MATERIALS:

A. W-Shapes: ASTM A992; ASTM A572, Grade 50 or 55; or ASTM A529, Grade 50 or 55.

B. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36; ASTM A572, Grade 50 or 55 (345 or 380); or ASTM A529, Grade 50 or 55 (345 or 380).

C. Plate and Bar: ASTM A36; ASTM A572, Grade 50 or 55 (345 or 380); or ASTM A529, Grade 50 or 55 (345 or 380).

D. Structural-Steel Sheet: Hot-rolled, ASTM A1011, Structural Steel (SS), Grades 30 through 55 (205 through 380), or High-Strength Low Alloy Steel (HSLAS), Grades 45 through 70 (310 through 480); or cold-rolled, ASTM A 1008, Structural Steel (SS), Grades 25 through 80 (170 through 550), or High-Strength Low Alloy Steel (HSLAS), Grades 45 through 70 (310 through 480).

E. Metallic-Coated Steel Sheet Pre-painted with Coil Coating: Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A755.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 (230 through 550) or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80 (340 through 550); with G90 (Z275) coating designation.

F. Joist Girders: Manufactured according to "Standard Specifications for Joist Girders," in SJI's "Standard Specifications, Load Tables, and Weight Tables for Steel Joists and Joist Girders," with steel-angle, top- and bottom-chord members; with end- and top-chord arrangements as indicated and required for primary framing.

G. Steel Joists: Manufactured according to "Standard Specifications for Open Web Steel Joists (K-Series or LH-Series)" in SJI's "Standard Specifications, Load Tables, and Weight Tables for Steel Joists and Joist Girders," with steel-angle, top- and bottom-chord members; with end- and top-chord arrangements as indicated and required for secondary framing.

H. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade, carbon-steel, hex-head bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.

1. Finish: Hot-dip zinc coating, ASTM A153, Class C.

I. High-Strength Bolts, Nuts, and Washers: ASTM A490, Type 1, heavy hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563 heavy hex carbon-steel nuts; and ASTM F436 hardened carbon-steel washers, plain.

J. Unheaded Anchor Rods: ASTM F1554, Grade 36; ASTM A572; Grade 50 ASTM A36 ASTM A 307, Grade A

1. Configuration: Straight.
2. Nuts: ASTM A 563 heavy hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F436 hardened carbon steel.
5. Finish: Hot-dip zinc coating, ASTM A153, Class C.

K. Headed Anchor Rods: ASTM F1554, Grade 36; ASTM A307, Grade A, straight.

1. Nuts: ASTM A563 heavy hex carbon steel.
2. Plate Washers: ASTM A36 carbon steel.
3. Washers: ASTM F436 hardened carbon steel.
4. Finish: Hot-dip zinc coating, ASTM A153, Class C.

L. Threaded Rods: ASTM A 193; ASTM A572, Grade 50; ASTM A36; ASTM A307, Grade A.

1. Nuts: ASTM A563 heavy hex carbon steel.
2. Washers: ASTM F 436 hardened ASTM A36 carbon steel.
3. Finish: Hot-dip zinc coating, ASTM A153, Class C.

M. Primer: SSPC-Paint 15, Type I, red oxide.

2.3 MATERIALS FOR FIELD-ASSEMBLED METAL PANELS:

A. Metallic-Coated Steel Sheet Pre-painted with Coil Coating: Steel sheet metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A755.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653, Structural Steel (SS), Grades 33 through 80, with G90 coating designation.
2. Surface: Smooth, flat finish.
3. Exposed Finishes: Apply the following coil coating:

a. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions, except as modified below:

1) Humidity Resistance: 2000 hours.
2) Salt-Spray Resistance: 2000 hours.

2.4 THERMAL INSULATION FOR FIELD-ASSEMBLED METAL PANELS:

A. Metal Building Insulation: ASTM C991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch- wide, continuous, vapor-tight edge tabs; and with a flame-spread index of 25 or less.

B. Vapor-Retarder Facing: ASTM C1136, with permeance not greater than 0.02 perm when tested according to ASTM E96, Desiccant Method.

C. Retainer Strips: 0.019-inch- thick, formed, galvanized steel or PVC retainer clips colored to match insulation facing.

D. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.5 DOOR AND FRAME MATERIALS:

A. Refer to Division 08 Section 081113, "Hollow Metal Door & Frame."

2.6 DOORS HARDWARE:

A. Refer to Division 08 Section 087100, "Door Hardware."

2.7 MISCELLANEOUS MATERIALS:

A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.

1. Fasteners for Metal Roof and Wall Panels: Self-drilling Type 410 stainless-steel or self-tapping Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal panels.
2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
3. Blind Fasteners: High-strength stainless-steel rivets.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, non-corrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

D. Metal Panel Sealants:

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape of manufacturer's standard size.
2. Joint Sealant: ASTM C920; one-part elastomeric polysulfide, sealant; of type, grade, class, and use classifications required to seal joints in metal panels and

remain weathertight; and as recommended by metal building system manufacturer.

E. Sealants for other locations:

1. Joint Sealant: ASTM C920; one-part elastomeric polyurethane or silicon rubber sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

F. Furring Channels (Furring Members):

1. Steel Studs: ASTM C645, in depth to accommodate board insulation.

a. Minimum Base Metal Thickness: 0.0312 inch.

G. Thermal insulation under concrete slab and interior side of concrete knee wall:

1. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV, 1.60-lb/cu. ft. minimum density, unless otherwise indicated; with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively.

2.8 FABRICATION:

A. Design components and field connections required for erection to permit easy assembly.

1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.

B. Tolerances: Comply with MBMA's "Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."

C. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.9 STRUCTURAL FRAMING:

A. General:

1. Primary Framing: Shop-fabricate framing components to indicated size and section with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.

    a. Make shop connections by welding or by using high-strength bolts.
    b. Join flanges to webs of built-up members by a continuous submerged arc-welding process.
    c. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
    d. Weld clips to frames for attaching secondary framing members.
    e. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary structural members with specified primer after fabrication.

2. Secondary Framing: Shop-fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

    a. Make shop connections by welding or by using non-high-strength bolts.
    b. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop-prime uncoated secondary structural members with specified primer after fabrication.

B. Primary Framing: Manufacturer's standard structural primary framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. Provide frames with attachment plates, bearing plates, and splice members. Factory-drill for field-bolted assembly. Provide frame span and spacing indicated.

    a. Slight variations in span and spacing may be acceptable if necessary to meet manufacturer's standard, as approved by the Designer..

2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
3. Exterior Column Type: Uniform depth or Tapered.
4. Rafter Type: Uniform depth or Tapered.

C. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:

1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet; with minimum thickness of 0.0598 inch (1.5 mm).
2. End-Wall Rafters: C-shaped, cold-formed, structural steel sheet; with minimum thickness of 0.0598 inch (1.5 mm); or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.

D. Secondary Framing: Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet pre-painted with coil coating, unless otherwise indicated, to comply with the following:

1. Purlins: C- or Z-shaped sections; fabricated from minimum 0.0598-inch-thick steel sheet, built-up steel plates, or structural steel shapes; minimum 2-1/2-inch-wide flanges.
2. Girts: C- or Z-shaped sections; fabricated from minimum 0.0598-inch- thick steel sheet, built-up steel plates, or structural steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange and with minimum 2-1/2-inch- wide flanges.
3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from 0.0598-inch-thick steel sheet, built-up steel plates, or structural steel shapes; to provide adequate backup for metal panels.
4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural steel angles or 1-inch diameter, cold-formed structural tubing to stiffen primary frame flanges.
5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural steel angles.
6. Base or Sill Angles: Minimum 3-by-2-by-0.0598-inch zinc-coated (galvanized) steel sheet.
7. Purlin and Girt Clips: Minimum 0.0598-inch-thick, steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
8. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from minimum 0.0598-inch- thick, zinc-coated (galvanized) steel sheet.
9. Framing for Openings: Channel shapes; fabricated from minimum 0.0598-inch-thick, cold-formed, structural-steel sheet or structural steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.
10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
11. Rods: ASTM A36; ASTM A572, Grade 50; or ASTM A529, Grade 50; minimum 1/2-inch- diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
12. Cable: ASTM A475, 1/4-inch- diameter, extra-high-strength grade, Class B zinc-coated, 7-strand steel; with threaded end anchors.
13. Angles: Fabricated from structural steel shapes to match primary framing, of size required to withstand design loads.

14. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural steel shapes to match primary framing; of size required to withstand design loads.
15. Fixed-Base Columns: Fabricate from shop-welded, built-up steel plates or structural steel shapes to match primary framing; of size required to withstand design loads.
16. Diaphragm Action of Metal Panels: Design metal building to resist wind and seismic forces through diaphragm action of metal panels.
17. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.

E. Bolts: Provide plain finish bolts for structural framing components that are primed or finish-painted. Provide hot-dipped galvanized bolts for structural framing components that are galvanized.

F. Factory-Primed Finish: Apply specified primer immediately after cleaning and pre-treating.

1. Prime primary, secondary, and end-wall structural framing members to a minimum dry film thickness of 1 mil (0.025 mm).

   a. Prime secondary steel framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2. Prime galvanized members with specified primer, after phosphoric acid pre-treatment.

2.10 METAL ROOF PANELS:

A. Vertical-Rib, Standing-Seam Metal Roof Panels: Roll formed with two (2) major vertical ribs 24 inches on center and intermediate stiffening flutes perpendicular to major vertical ribs six (6) inches on center running entire length of panel; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
1. Basis of Design: MR- 24 roof System by Butler Manufacturing Company.
2. Material: Zinc-coated (galvanized steel sheet, 0.024 inch thick.

   a. Exterior Finish: Fluoropolymer.
   b. Color: As selected by Designer from manufacturer's full range.

3. Clips: Manufacturer's standard, floating type to accommodate thermal movement; fabricated from zinc-coated (galvanized) steel sheet.
4. Joint Type: Mechanically seamed**,** folded as standard with manufacturer.
5. Panel Coverage: 24 inches.
6. Panel Height: 2 inches.
7. Uplift Rating: UL 90.

2.11 FIELD-ASSEMBLED METAL WALL PANELS:

A. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Roll-formed with raised, trapezoidal four (4) major ribs and two (2) intermediate stiffening ribs symmetrically spaced between each major rib; designed to be field-assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Basis of Design: Butlerrib II Wall System by Butler Manufacturing Company
2. Material: Zinc-coated (galvanized) steel sheet, .0.024 inch thick.

   a. Exterior Finish: Fluoropolymer.
   b. Color: As selected by Designer from manufacturer's full range.

3. Major-Rib Spacing: 12 inches on center.
4. Panel Coverage: 36 inches.
5. Panel Height: 1.5 inches.

B. Flush-Profile, Metal Liner Panels: Solid panels formed with vertical panel edges and flat pan between panel edges; with flush joint between panels; designed for interior side of field-assembled metal wall panel assemblies and field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using exposed fasteners in side laps.

1. Material: Zinc-coated (galvanized) steel sheet, 0.0209 inch thick.

   a. Finish: Acrylic enamel.
   b. Color: As selected by Designer from manufacturer's full range.

2.12 ACCESSORIES:

A. Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.

2. Clips: Manufacturer's standard, formed from stainless-steel sheet, designed to withstand negative-load requirements.
3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from steel stainless-steel sheet.
4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1 inch standoff; fabricated from extruded polystyrene.

C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

D. Flashing and Trim: Formed from minimum 0.0159 inch thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.

1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
2. Opening Trim: Minimum 0.0269-inch thick, metallic-coated steel sheet. Trim head and jamb of door openings, and head, jamb, and sill of other openings.

E. Gutters: Formed from minimum 0.0159-inch thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch long sections, sized according to SMACNA "Architectural Sheet Metal Manual."

1. Gutter Supports: Fabricated from same material and finish as gutters; spaced 36 inches on center.
2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.

F. Downspouts: Formed from 0.0159-inch thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters; spaced 10 feet on center.

G. Snow Guards: Prefabricated, non-corrosive units designed to be installed without penetrating roof panel, with predrilled holes and clamps or hooks for anchoring.

1. Metal-Type Guard: Consisting of aluminum or stainless-steel rods or bars held in place by supports clamped to vertical ribs of standing-seam roof.

a. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1) LMCurbs; S-5! SnoFence.
2) Riddell & Company, Inc.; Snobar.
3) Snow Management Systems; Vermont Snowguard.

H. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.13 PLYWOOD BACKING PANELS:

A. Electrical Equipment Backing Panel: DOC PS 1, Exposure 1 C-D Plugged, fire-retardant treated in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.14 FINISHES:

A. Comply with NAAMM "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.15 SOURCE QUALITY CONTROL:

A. Special Inspector: Engage a qualified special inspector to perform the following tests and inspections and to submit reports. Special Inspector will verify that manufacturer

maintains detailed fabrication and quality-control procedures and will review the completeness and adequacy of those procedures to perform the Work.

1. Special inspections will not be required if fabrication is performed by a manufacturer registered and approved by authorities having jurisdiction to perform such Work without special inspection.

    a. After fabrication, submit certificate of compliance with copy to authorities having jurisdiction certifying that Work was performed according to Contract requirements.

B. Tests and Inspections:

1. Bolted Connections: Shop-bolted connections shall be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
2. Welded Connections: In addition to visual inspection, shop-welded connections shall be tested and inspected according to AWS D1.1 and the following inspection procedures, at inspector's option:

    a. Liquid Penetrant Inspection: ASTM E165.
    b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
    c. Ultrasonic Inspection: ASTM E164.

C. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, with Erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. For the record, prepare written report, endorsed by Erector, listing conditions detrimental to performance of work.

B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedment to receive structural framing, with Erector present, for compliance with requirements and Metal Building System Manufacturer's tolerances.

1. Engage a land surveyor to perform surveying.

C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING:

A. Erect Metal Building System according to Manufacturer's written erection instructions and erection drawings.

B. Do not field-cut, drill, or alter structural members without written approval from the Metal Building System Manufacturer's Professional Engineer.

C. Set structural framing accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing and other detrimental materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
3. Promptly pack grout solidly between bearing surfaces and plates to eliminate any voids. Neatly finish exposed surfaces; protect grout to cure. Comply with Manufacturer's written installation instructions for shrinkage-resistant grouts.

E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.

F. Primary Framing and End Walls: Erect framing true to line, level, plumb, rigid, and secure. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nut anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

a. Joint Type: Snug tightened or pre-tensioned.

G. Secondary Framing: Erect framing true to line, level, plumb, rigid, and secure. Fasten secondary framing to primary framing using clips with field connections using non-high-strength bolts.

1. Provide rake or gable purlins with tight-fitting closure channels and fascia.
2. Locate and space wall girts to suit openings for doors.
3. Provide supplemental framing at entire perimeter of openings, including doors, and other penetrations of roof and walls including Roof Structure over walkway between existing and new structures.

H. Steel Joists: Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications, Load Tables, and Weight Tables for Steel Joists and Joist Girders," joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Bolt joists to supporting steel framework using carbon-steel bolts, unless otherwise indicated.
5. Bolt joists to supporting steel framework using high-strength structural bolts, unless otherwise indicated. Comply with RCSC "Specification for Structural Joints Using ASTM A325 or A490 Bolts" for high-strength structural bolt installation and tightening requirements.
6. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.

1. Tighten rod and cable bracing to avoid sag.
2. Locate interior end-bay bracing only where indicated.

J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

K. Erection Tolerances: Maintain erection tolerances of structural framing within AISC "Code of Standard Practice for Steel Buildings and Bridges."

3.4 METAL PANELS:

A. Examination: Examine primary and secondary framing to verify that structural panel support members and anchorages have been installed within alignment tolerances required by Manufacturer.

1. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before metal panel installation.

B. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movements.

1. Field-cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.

a. Field-cutting of metal panels by torch is not permitted unless approved in writing by the Manufacturer.

2. Install metal panels perpendicular to structural supports, unless otherwise indicated.
3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
6. Lap metal flashing over metal panels to allow moisture to run over and off the material.

C. Lap-Seam Metal Panels: Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or metal panels. Install screws in pre-drilled holes.

1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.

D. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal panel manufacturer.

1. Seal metal panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in CSI Division 07 Section 079200, "Joint Sealants."

3.5 METAL ROOF PANELS:

A. Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations.

1. Install ridge caps as metal roof panel work proceeds.
2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.

B. Field-Assembled, Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by Manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in Manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
5. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Pre-drill panels for fasteners.
6. Provide metal closures at peaks each side of ridge caps.

C. Field-Assembled, Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal roof panels.

2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels; on side laps of ribbed or fluted metal panels; and elsewhere as needed to make metal panels weatherproof to driving rains.
4. At metal panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

D. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

E. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 METAL WALL PANELS:

A. Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movements.

1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
2. Shim or otherwise plumb substrates receiving metal wall panels.
3. When two rows of metal panels are required, lap panels 4 inches (102 mm) minimum.
4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
5. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Pre-drill panels.
6. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
7. Install screw fasteners in pre-drilled holes.
8. Install flashing and trim as metal wall panel work proceeds.
9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated, or if not indicated, as necessary for waterproofing.
10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws.
11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Field-Assembled, Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by Manufacturer.

1. Field-Insulated Assemblies: Install thermal insulation as specified. Install metal liner panels over insulation on interior side of girts at locations indicated. Fasten with exposed fasteners as recommended by Manufacturer.

C. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet non-accumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 THERMAL INSULATION INSTALLATION FOR FIELD-ASSEMBLED METAL PANELS:

A. Install insulation concurrently with metal wall panel installation, in thickness indicated to cover entire wall, according to manufacturer's written instructions.

1. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for fire-stopping.
2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths with both sets of facing tabs sealed to provide a complete vapor retarder.
4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation with both sets of facing tabs sealed to provide a complete vapor retarder.

B. Blanket Roof Insulation: Comply with the following installation method:

1. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Hold in place by metal roof panels fastened to secondary framing.
2. Between-Purlin Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder facing tabs up and over purlin, overlapping adjoining facing of next insulation course maintaining continuity of retarder. Hold in place with bands and crossbands below insulation.
3. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
4. Two-Layers-between-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder facing tabs up and over purlin, overlapping adjoining facing of next insulation course maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space

between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.

5. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
6. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.

C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Hold in place by metal wall panels fastened to secondary framing.

1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
2. Sound-Absorption Insulation: Where sound-absorption requirement is indicated for metal liner panels, cover insulation with polyethylene film and provide inserts of wire mesh to form acoustical spacer grid.

3.8 ACCESSORY INSTALLATION:

A. Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Install components for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
3. Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed

within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet (1.2 m) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Tie downspouts to underground drainage system indicated.

E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.9 FIELD QUALITY CONTROL:

A. Testing Agency: Engage a qualified testing and inspecting agency to perform foundation tests and inspections and to submit reports.

B. Tests and Inspections:

1. High-Strength, Field-Bolted Moment Connections: Connections shall be tested and inspected during installation according to RCSC "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1 and the following inspection procedures, at inspector's option:

a. Liquid Penetrant Inspection: ASTM E165.
b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
c. Ultrasonic Inspection: ASTM E164.

C. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract.

3.10 CLEANING AND PROTECTION:

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.

1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning."
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

D. Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.

E. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 133419

SECTION 144500 - VEHICLE LIFTS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes:

1. Heavy duty modular, in-ground scissor vehicle lift designed for lifting vehicles weighing up to 90,000 lbs.
2. Heavy duty mobile column lifting system designed for lifting vehicles weighing up to 108,000 lbs.
3. Surface mount 2-post vehicle lift designed for lifting vehicles weighing up to 20,000 lbs.

1.2 SUBMTTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data shall include catalog sheets and installation instructions. In addition include telephone number of nearest fully equipped service organization.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings indicating construction details of the lift system. Indicate electric wiring and control system.

D. Quality Assurance Submittals:

1. Installer certificates.
2. Design data, including safety factor of materials.
3. Certificate and Test report of each lift system.
4. Test reports of the lift.

E. Operation and Maintenance Data: Include complete operating and maintenance instructions for each component of the lift specified in Form 818 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

F. Warranties: As specified in this Section.

1.3 REFERENCES:

A. ANSI/ALI ALCTV-1998 Adopted 6/98 and mandatory effective 4/2000.

B. ANSI, ALI/ETL ALCTV 1998 Automotive Lift Standard.

C. ANSI/ALI OIM STANDARD # ALOIM-1994, And Lift Point Guides.

D. UL - 201.

E. NEC.

F. OSHA.

1.4 QUALITY ASSURANCE:

A. The completed vehicle lift system shall be essentially the product of one lift manufacturer regularly engaged in the production of such equipment.

B. Clearly label lift to indicate maximum capacity. Letter lift rated capacities on the control box.

C. Equipment must meet OSHA, UL-201, NEC, and the latest ANSI Standard ANSI/ALI ALCTV-1998 Adopted 6/98 and mandatory effective 4/2000.

D. Equipment must be structurally and safety tested and certified to ANSI, ALI/ETL ALCTV 1998 Automotive Lift Standard.

E. Equipment must be supplied with all ANSI, ALI/ETL safety data, safety booklets, ANSI/ALI OIM Standard # ALOIM-1994, and lift point guides. Safety decals must be permanently placed on the lift in clear view of the operator.

F. Model of lift must have been in production for at least 3 years and be the manufacturer's current production model.

G. System Marking: Major components of the system shall be marked at the factory to assure prompt and proper field identification.

H. Secure the services of a Company Field Advisor for the following:

1. Render advice regarding installation of the lift system.
2. Witness final system test and then certify with an affidavit that the lift system is installed in accordance with the Contract and is operating properly.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Equipment shall be protected against damage during shipment.

1.6 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information

B. Special Warranty: Manufacturer's standard form in which manufacturer/installer agrees to repair or replace components of lift system that fails in materials or workmanship for an extended coverage period, as stated in the manufacturer's standard warranty, from the issuance of the Certificate of Compliance.

1. Warranty Period: Three years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 EQUIPMENT:

A. Complete assembly shall consist of an electro-hydraulic lift unit, a control console and accessories.

1. Basis of Design: Provide the following, or an approved equal:

a. Repair Bays: 90,000 Lbs. minimum lifting capacity: Model EFX90-13 252/96 Tandem In-Ground Scissor Lift as manufactured by Rotary Lift. Quantity two (2) for this Project.
b. Repair Bays: 20,000 Lbs. minimum lifting capacity Model SPO20 – standard 2-Post Lift as manufactured by Rotary Lift.
c. 108,000 Lbs. minimum lifting capacity: Model MCH618 Wireless as manufactured by Rotary Lift. Quantity one (1) for this Project.

B. Complete assembly shall permit lifting of vehicles to any height up to the full amount specified.

2.2 MODULAR IN-GROUND SCISSOR LIFTS:

A. Description: The lift shall consist of three lifting assemblies in line with the longitudinal axis of the vehicle, each lifting mechanism so equipped as to engage the axle and/or suspension as specified herein. One of the lifting mechanisms, will be movable fore and aft, to affect variable spacing between lifting mechanisms. The other lift assembly will be fixed.

1. Lift shall meet the following description: axle engaging, hydraulic / mechanical in-ground scissor articulating lift, with a fixed rear and movable front lifting unit. Total pit depth shall not exceed 34 inch (864 mm) below finished floor when installed in a concrete containment. The safety system shall include lockable, "press-to-lock" mechanical locks, and the lift shall have high pressure / low

volume cylinders operated from a main console or optional pendant. The front lifting unit shall move fore and aft while fully recessed below floor and the entire lift system shall be drop-in, bolt-in and be completely removable and re-locatable.

2. Lift is to be installed in a shallow concrete containment or precast pit, and equipment is not to exceed 34 inches (864 mm) below finished floor; any fluids in the containment shall drain to the oil/water separator or be ejected into the user's specified collection system; cylinders shall operate at greater than 2500 psi and require less than a total of 3.5 gallons (13.25 L) each of hydraulic oil for lifting to full height; electric motors and reservoirs for oil shall be above ground in the control console; cylinders shall be double-acting with internal seals and have a maximum piston rod extension of 21 inches (533 mm) to reduce vulnerability to damage and increase maintenance reliability; the moveable lifting unit shall recess below floor anywhere within the travel range and shall be movable fore and aft when fully recessed; mechanical locking system shall have a "press-to-lock" push button to seat the locks in a fully engaged and locked position and relieve the hydraulic pressure; lift shall have a manual hand pump located in the console capable of lowering the lift in the event of a power or component failure to remove the vehicle; structural pit covers with a continuous hinge capable of supporting a 13,500 lb (6123 kg) drive over load; movable front lifting carriage that slides over low friction, low wear Nylatron in lieu of rollers and axles; the lift system shall not be embedded in concrete and shall be completely removable and re-locatable.

B. Dimensions and Capacities:

1. Lifting Capacity: Lift shall be capable of raising 30,000 lbs. (13608 kg) per scissor section. The lift system can be operated with two or three scissor assemblies.
2. Unbalanced Loads, Front to Rear: Lift shall be capable of raising 30,000 lbs (13608 kg) on one unit and 0 (zero) lbs. on the other unit.
3. Design Load Factor of Safety: 3:1.
4. Number of Mechanical Lock Stops: 12, minimum.
5. Vertical height spacing between each lock stop: 5 inches (127 mm), maximum.
6. Vertical rise to first lock stop: 14 inches (356 mm), maximum.
7. Rise: 70 inches (1778 mm) A.F.F. (above finished floor)
8. Lifting Rate: 80 seconds; 50 inches (1270 mm) per minute, minimum.
9. Maximum Depth Below Finished Floor for any structural component or member: 34 inches (864 mm) maximum.
10. Front and Rear Synchronization: 2 inches (51 mm)
11. Bolster Width: 40 inches (1016 mm) minimum.
12. Adapter Adjustment: Minimum 18 inches (457 mm); Maximum 52 inches (1321 mm)
13. Bolster and Base Adapters for both lifting units, movable and fixed, shall recess below finished floor. Base adapters shall not require pinning or locking mechanisms, but shall have retaining bolts.
14. Wheelbase: From 96 inches to 252 inches.
15. Drive-over capacity for interlocking, extruded structural aluminum covers: 13,500 lbs (6123 kg).

C. Lift Units:

1. Independent Lifting Units, Front and Rear, shall be exactly identical, completely interchangeable and share the same operating and performance parameters for capacity, lifting rate, height and stroke.
2. Movable lifting unit shall be mounted inside a steel insert, also known as a continuous recess.
3. Lift units and continuous recess insert shall be completely removable with no lift components or structural framing permanently embedded in the concrete.
4. Lift unit shall be a hydraulically powered, mechanically articulating scissor lift, complete with a mechanical locking system.
5. Hydraulic cylinder shall be dual acting so that the lift descends and then retracts below finished floor into the recess under power, after disengaging from the axle load.
6. Lift units shall be able to disengage from the axles at differing times and elevations and power down to their retracted positions at the same rate of descent as when fully loaded.
7. Lift unit shall be constructed of 2 inch (51 mm) thick bars, 2 inch (51 mm) thick inner leg assembly weldments, 2.25 inch (57 mm) diameter 4140 pins, greaseless polygon bushings, a 3/4 inch (19 mm) thick T-1 steel dual lock-jaw weldment, 7 inch (178 mm) diameter double-acting hydraulic cylinder, and UHMW slide blocks.
8. All steel surfaces shall be finished in a high wear epoxy coated paint.
9. By means of a centering link, the lifting structure shall articulate symmetrically about the center axis of the lift unit as it raises and lowers. As the lift raises and lowers, the top and bottom pins and sliding load blocks, shall travel toward and away from the centerline of the longitudinal axis of the lift at an equal rate and distance.

D. Continuous Recess / Movable Carriage Lifting Units:

1. The front unit shall be movable fore and aft while in the fully retracted position. The travel frame for the movable carriage shall be comprised of a drop-in, bolt-in-place open floor steel box insert that is completely removable and re-locatable.
2. When the entire travel frame insert has the covers in place and the lift is operational, it forms a continuous recess that shall meet the following design and performance criteria:

    a. The movable lift unit shall not be required to recess, or park, in only one "pocketed" location, providing increased productivity in servicing fleet vehicles of varying wheelbases.
    b. The movable lifting unit may be recessed below finished floor at any position between the minimum and maximum dimensions of the travel range.
    c. The lift unit shall be capable of fore and aft travel while recessed below floor.

3. Maximum depth below finished floor for the continuous recess insert, shall be 34 inches (864 mm)
4. The steel box insert shall have an open floor design, mounted off the concrete floor of the trench to allow for the collection, cleaning and drainage of all liquids and solids that accumulate in the trench.
5. The continuous recess shall have structurally shaped inter-locking extrusions that form a continuous movable cover that conveys along a top and bottom track and remains in the recess. These covers shall provide continuous closure over the trench as the carriage unit moves fore and aft. Flat plates that slide along the floor past the trench ends are not acceptable.
6. The covers shall be anodized structural 6061 aluminum extrusions engineered to accept a 7500 pound (3402 kg) point load and shall be shaped to include a full-length interlocking hinge. Covers shall fit together tightly and uniformly to promote smooth and even travel and prevent jamming and twisting. Covers that have open gaps and are loosely fastened together by cotter pins or other fasteners will not be accepted.
7. The covers shall be extruded with an anti-skid surface.
8. For service and repair, the cover plates shall be removable by sliding the covers apart to provide quick and easy access to the trench.
9. The movable carriage lifting unit shall be positioned by a bi-directional hydraulic drive motor mounted on the carriage to position it fore and aft to match the wheelbase.
10. The travel frame shall have a machined UHMW cover guide block at each end that tapers and self-aligns the covers about the centerline of the lift unit as the covers travel in and out of the recess.
11. The movable carriage unit and the covers shall bear on and slide over low friction, low maintenance, low wearing Nylatron surfaces. Rollers and axles will not be accepted.
12. The powered carriage drive shall have rack and gear engagement on both the left and right sides for smooth and even fore-aft travel without binding.
13. The rack shall be inverted and positioned under the load channel of the insert where it is protected so as not to collect dirt, grease etc.
14. The hydraulic drive motor shall freewheel such that, if the unloaded lift unit accidentally gets bumped, it will move freely without breaking any chains, racks or gears.
15. The hydraulic drive motor shall have a pre-set pressure switch to prevent fore-aft movement of a loaded lift unit carriage. The pressure switch will also prevent overdriving of the motor once it reaches either end of the travel frame.
16. No chains, sprockets or point-loading tapered rollers to power the movable carriage will be accepted.
17. Access holes for PVC conduits and wall fastener locations shall be provided in the walls of the continuous recess insert.
18. All hydraulic and compressed air service lines shall be fed from the control console to the insert through one PVC conduit.

19. Hose connections shall be made at a single bracket with bulkhead fittings. The hydraulic and pneumatic service lines from the bulkhead to the carriage shall be pre-piped at the factory.
20. All low voltage and intrinsically safe electrical components shall be fed to/from the control console to the lifting units via a rigid conduit that meets local requirements.

E. Fixed Lifts:

1. The stationary lift shall be of the same design and construction as the moveable lift unit.
2. The base of the fixed lift shall be installed 34 inches (964 mm) below finished floor.
3. The rear lift unit shall be drop-in, and bolted in-place with eight (8) 3/4 inches (19 mm) anchors.

F. Hydraulic Systems:

1. System shall be comprised of two (2) high pressure, low volume, double-acting 7 inches (178 mm) diameter cylinders, one at each lifting unit, operating at greater than 2500 psi (17237 kPa).
2. Combined, the two cylinders shall only require 7 gallons (26.5 L) of AW 32 hydraulic oil for lifting to full height.
3. Each cylinder shall have a hose break velocity fuse (safety check valve) integrally mounted to prevent excessive loss of fluid from the cylinder.
4. Each double acting cylinder shall have both power-up and power-down capability to ensure smooth and efficient ascent/descent. Lifts designed to operate with power up, gravity down are not acceptable.
5. There shall be two hoses to each cylinder, one each for extend and retract.
6. The hoses shall be of steel reinforced construction and have O-ring Face Seal fittings throughout.
7. The lift shall be driven by matched gear pumps of U.S. manufacturer, readily available as an off-the-shelf component.
8. The lift shall be able to be raised from the locked position, and lowered from any position by means of a manual hand pump and manual override valves located in the control console.
9. High pressure seals shall be internal to the cylinder where they are protected from salt, dirt, corrosives etc. Low pressure seals for cylinders operating at 550 psi or less, which are exposed and vulnerable, are not acceptable.
10. The power unit shall be equipped with a replaceable filter element mounted in the tank top. The element must be a super fine, high efficiency, high capacity micro glass element to provide maximum service life with consistent removal efficiency.
11. The hoses feeding the front movable lift carriage shall be supported and contained by a cable carrier to prevent the hoses from dragging or tangling. The cable carrier shall be aligned and mounted to the carriage to ensure smooth operation of the carriage through its fore/aft travel.

G. Control Systems:

1. The control system shall conform to all current NEC, UL 201 and OSHA codes.
2. The control system shall be PLC operated and continuously monitor all operating functions and safety systems of the lifting units and movable carriage. The control system shall utilize intrinsically safe components that constantly monitor the lift system to ensure synchronized and equalized operation.
3. Audio and visual feedback controls that communicate operating fault codes and lockouts to the operator shall be part of the control system.
4. The electrical enclosure for control components shall be NEMA 4X rated and have following controls mounted on the front cover:

    a. Disconnect Switch, 3-phase.
    b. Power On-Off Switch.
    c. Push/Turn E-Stop Button.
    d. Push buttons for Lift Raise, Lower and Lock.
    e. Power On and fault code indicator lamps.
    f. Selector switch for synchronized, front, or rear lifting.
    g. Push buttons for hydraulic movable carriage drive.

5. Hardwired, redundant Emergency E-Stop circuit that de-energizes the motor outputs shall be standard.
6. Multi-voltage 208/230/460 3 phase, 60 Hz TEFC 10 Hp motor of U.S. manufacture.
7. Control console shall be equipped with a main power disconnect switch which interrupts all incoming power. Main power disconnect shall be lock-out capable.
8. Control door access shall be restricted.
9. Console access panels shall be easy to remove and install.
10. Automatic Wheel Base Positioning shall be standard.

    a. The control system shall be equipped with a programmable wheelbase positioning system. The system shall be capable of storing up to 16 different vehicle profiles. This positioning system will allow a user to select and position vehicles easier.

11. The control system shall prohibit horizontal movement of the moveable lifting assembly when the unit is raised 1" above finished floor.
12. The control system shall illuminate a blue light on the control panel when the lift has reached its fully retracted position (HOME). This light is an indicator that the lift stored and it is clear to move a vehicle into or out of a bay.

H. Safety Systems:

1. Each lifting unit shall be equipped with double lock jaw, gravity engaging mechanical locks with the first lock position at a minimum lock height of 14 inches (356 mm).
2. The mechanical locks shall be made of high strength T-1 steel

3. The control system shall monitor locks open.
4. Each lifting cylinder shall be equipped with a hydraulic velocity fuse to prevent excessive loss of fluid from the cylinder in the event of a hose failure.
5. All push buttons shall be of the momentary contact, dead man type.
6. The control systems and optional pendant shall be equipped with an emergency E-Stop button that de-energizes power to all outputs of the PLC. Re-activation of the control system requires resetting the E-stop the control system.
7. The control system shall be designed to prevent accidental use of the main operator controls when the pendant is connected. Any attempt to use main controls with pendant attached will result in an operator lock-out.
8. Control console shall monitor for low air to prevent operating the lift without sufficient air pressure to open locks.

2.3 LIGHT DUTY 20,000 LB. CAPACITY SYMMETRIC TWO POST SURFACE MOUNTED FRAME CONTACT LIFT:

A. Capacity:

1. SPO20: 20,000 lbs.; 5000 lbs. per arm.

B. Height to Top of Overhead Bar:

1. Standard Model Adjustable 15 feet - 16 feet 6 inches.

C. Floor To Overhead Switch Bar:

1. Standard Model Adjustable: 14 feet 5 inches - 15 feet 11 inches.

D. Width Inside Columns: 126-15/32 inch.

E. Overall Width: 13 feet-5 inch.

F. Drive Through Clearance At Tires: 111-11/32 inches.

G. Rise:

1. Standard Models: 89-1/2 inches from floor level to top of adapter fully extended.

H. Finishes (Excluding Arms) - All Arms Are Yellow:

1. Blue, Standard .

I. Single Point Manual Controls - Manual Lock Release Electric Power Unit, UL201 Compliant, Over Hydraulic Cylinder Drive: All models bio-fluid compatible.

1. 4hp 208-230V 1 phase Motor 60Hz.

J. Arm Configurations:

1. 2-Stage Arms With Flip Up Adapters:

    a. Front and Rear Arms: Minimum Reach 34-11/16 inches - Maximum Reach 64 inches Minimum Adapter Height 5-31/32 inches - Maximum Adapter Height 8-1/32 inches from floor.

K. Lift shall be 3rd party certified by ETL testing laboratory and labeled with the ETL/Automotive Lift Institute (ALI) label that affirms the lifts meet conformance to all applicable provisions of American National Standard ANSI/ALI ALCTV and in compliance with IBC chapter 30 section 3001.2.

L. Accessories:

1. Air/Electric Utility Box.
2. Tool Holder.
3. Door Defender.

2.4 WIRELESS MOBILE COLUMN LIFT:

A. Lift Characteristics:

1. The intent of this specification is to establish the minimum standards of quality and performance for portable mobile column lifts which will be used to lift a variety of vehicles including Trucks, Buses, Passenger Vehicles, Fork Lifts and other general service vehicles. This specification shall describe a mobile column surface mounted, wheel engaging lifting system designed to elevate vehicles for the purpose of inspection and maintenance. One Lifting System shall consist of six electric-hydraulic mobile columns sustaining 108,000 lb (48988 kgs) capacities (18,000 lbs (8165 kgs) per mobile column). Mobile columns may be added, (not exceeding 8 columns), removed, or changed out. All mobile columns shall operate synchronously from any one of the lifting units by means of a control interface. The control system shall have replaceable printed circuit boards equipped with quick-connect electrical couplers. The mobile columns shall be battery operated with a DC charging system built into each column for easy recharge and wireless communication.

B. General Requirements:

1. Capacity 108,000 lbs; 18,000 lbs. per column.
2. Shipping Weight: 1485 lbs (674 kg).
3. Weight Per Column: 1400 lbs. (635 kg).
4. Lifting Fork Length: 14 inches (356 mm) forks accommodate rim sizes 9 inches (229 mm) minimum to 24-1/2 inches (622 mm) maximum.
5. Floor requirements 4-1/2 inches thick (minimum) 3000 psi concrete not to exceed a side to side floor slope of 1/8 inch = 1 foot 0 inches and not to exceed a 1/4 inch = 1 foot 0 inches floor slope fore and aft.
6. Motor: 3kw, 24 volt minimum.

7. Hydraulic Tank Capacity: 10.5 quarts (10 liters) mobile columns will require 11-1/2 quarts (11 liters) of fluid to fill tank, hoses, and cylinders. Bio-Fluid compatible.
8. Overall Height at Full Lower: 102 inches (2591 mm).
9. Overall Height at Full Rise: 144-3/8 inches (3677 mm).
10. Overall Width: 45-1/2 inches (1156 mm).
11. Overall Length: 48-9/16 inches (1234 mm).
12. Turning Radius: 45 inches (1143 mm).
13. Rise: 70 inches (1778 mm).
14. Lifting/Lowering Speed: 78 seconds to full rise - 54 seconds to fully lowered position.
15. Control Voltage: 24 volts DC. Rechargeable by 110 Volt Automatic Weather Tight Marine Charger.
16. Battery Charge Cycle: (New Battery) 15 - 20 cycles per charge at rated load of the lift.

C. Fabrication:

1. Column Assemblies:

a. Columns shall be constructed of formed channel fabrication from a single steel plate and shall not require welded seams to form the column structure.
b. Columns shall be further reinforced externally along their back face with structural steel angle for additional rigidity and extended service life. Rigid column design shall be protected from corrosion via sand blasted enamel painting of metal surfaces.
c. Each column shall be fabricated to a set of legs that will sit directly on the floor and provide a stable platform when lifting a load. When unloaded the mobile columns ride on a set of wheels to allow the units to be moved. When a vehicle is lifted, the wheels shall automatically retract and the lift shall sit down flat on its steel base and no lifted weight shall remain on the casters. Legs have an extended fork configuration that allows for extensions to be added at any time. Such extensions will permit the addition of longer forks to lift dual wheel assemblies or optional assemblies for lifting vehicles further away form the column assembly.
d. Each of the lifting units shall contain a mechanical locking latch mechanism completely separate from the drive of lifting system. This lock shall be gravity actuated with a spring loaded assist to ensure engagement at any position. Spacing between locking positions shall be a maximum of 3 inches (76 mm) in accordance with ALCTV-2011.
e. The column structures shall be easily moveable on three wheels consisting of two fixed heavy duty steel wheels and a dual rubber steering wheel mounted at the rear of the column. Columns shall come equipped with a hoisting hook for lifting by overhead crane and a fork lift pocket lifting points on each column for ease of relocation by standard fork lift.

2. Carriage Assemblies:

a. Each column assembly shall include a carriage assembly which consists of 4 Ultra High Molecular Weight (UHMW) roller bearings. These bearings shall be oil impregnated and shall not require any greasing or maintenance of any kind.
b. Each carriage assembly shall include a full enclosure for the lifting cylinder chrome rod. No part of the chrome lifting cylinder shall be exposed to impact at any time during the lifting stroke.
c. Forks shall provide a minimum of 12 inches of sufficient safety clearance between column and body of vehicle. Forks shall also be available in an extended configuration capable of supporting inboard tires on dual-wheeled axles.
d. Carriage assemblies shall come equipped with adjustable lifting forks to allow for adjustment of lifting forks for small tire applications to standard large tire applications without need for adapter sleeves. Forks shall include handles to facilitate the lateral adjustment of forks for narrower and wider tires. Adjustment shall be accomplished by release of a spring loaded lock on the top of the fork. When adjustment of the forks is complete, locks shall automatically re-engage to secure forks from further movement.

3. Hydraulic System:

a. Each lifting unit shall be equipped with an electric hydraulic power unit, consisting of a DC motor, gear pump, reservoir, check valve, pressure relief valve, and two control valves. Entire power unit totally enclosed to protect from dirt and water.
b. The direct drive lifting cylinder shall be installed in such a manner as to push the carriage up, using no chains or cables. The extension of the cylinder shall occur inside of the carriage as to keep the plunger of the cylinder protected from dirt, sand, or any possible mechanical damage.
c. Hydraulic check valve shall hold load at any position of the cylinder. Redundant mechanical safety lock shall be continuously engaged except while lift is being lowered.
d. Solid zinc plated steel pipes are used to circulate all hydraulic fluids in the system.
e. Pressure relief valve shall prevent overloading of the lifting unit.
f. Unit shall be equipped with two control valves that shall be used to maintain synchronous operation when a lifting system of more than one column is being commanded to raise or lower.
g. Hydraulic system is self-lubricating and shall require little to no maintenance.
h. A velocity fuse shall be installed directly to the end of the cylinder in order to keep hydraulic fluids from discharging if there is a fast leak somewhere after the cylinder, which could cause the load to unintentionally be lowered.

4. Control System: Wireless System.

a. All mobile columns shall have identical control panels and shall be designed to be interchangeable without regard to master/slave relationships.
b. All mobile control panels are waterproof NEMA Type 4.
c. All control circuits and motor power supply circuits shall be 24 volts.
d. Circuit board programming is upgradeable. Upgrades in software or control programming shall be available by swapping a memory stick only and board replacement or reprogramming by the user shall not be necessary. All mobile columns shall have a manual lowering override due to lose of power to the unit.
e. All mobile columns shall have a manual lowering override due to loss of power to the unit.
f. Indication lights on each control panel shall show mobile column configurations for an individual mobile column, paired mobile columns, grouped mobile columns, or all mobile columns.
g. "UP" and "Down" buttons shall have momentary function "Dead Man" type switches while depressed and operate from only one control panel at a time.
h. "Select" button shall permit operation of an individual mobile column, paired mobile columns, grouped mobile columns, or all mobile columns.
i. "Emergency Stop Button" on each panel will shut down all connected mobile columns.
j. All control panels have automatic synchronization through the full stoke of the hydraulic cylinder with a maximum tolerance of 1 inch.
k. Control system will actively control hydraulic correction to maintain level synchronization, unless a column deviates more than 3.5 inches from any other column, at which point all motion halts and an error alert is generated.
l. Error codes and other diagnostic information is automatically provided when a fault is detected via alpha-numeric display, audible alarm and visual indicator.
m. Programmable height limit settings with no external limit switches.
n. Lift shall come equipped with a lower to lock function.
o. Lift shall come equipped with a slow lowering function.
p. Each column shall have its own 110 volt waterproof marine, twenty (10) amps, 2 -bank battery smart-charger. The battery charger shall have two independent 12 VDC output leads and incorporate automatic 3-stage charging to minimize charge time and maximize battery life. Total recovery time for a completely discharged system is less than 12 hours. All battery chargers in a system can be connected together into a single 110V receptacle.
q. The lift control interfaces shall include visual representations showing the relationships between the lift columns and a vehicle, such as lift column icons positioned around a vehicle icon.
r. Lift shall come equipped with a three color battery charge indicator. The charger shall also indicate the status of the battery.

5. Steering:

a. The steering assembly shall consist of a fully automatic, spring-loaded steering handle. The steering handle shall lock the movement of the rear wheel when it is in the vertical position.
b. The steering assembly shall allow the lift to be moved around the shop floor without the need to pump up a hydraulic jack or pallet jack mechanism.
c. The rear wheel shall be spring loaded as to retract when weight is applied to the column. All other wheels will automatically retract when the lift is loaded with the weight of a vehicle. All wheels shall be equipped with sealed ball bearings.

6. Lift shall be 3rd party certified by ETL testing laboratory and labeled with the ETL/Automotive Lift Institute (ALI) label that affirms the lifts meet conformance to all applicable provisions of American National Standard ANSI/ALI ALCTV-2011 and in compliance with IBC chapter 30 section 3001.2.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Material shall be cleaned of loose rust, mill scale and foreign matter prior to shop painting.

B. Verify that conditions are in accordance with manufacturer's requirement prior to installation.

3.2 INSTALLATION:

A. Install in strict accordance with manufacturer instructions and in proper relationship with adjacent construction. Test for proper operation and retest if necessary until satisfactory results are achieved.

B. Install vehicle lifts in recessed slab so that the lift is at floor level.

3.3 FIELD QUALITY CONTROL:

A. Vehicle lifts shall be load tested in accordance with manufacturer's requirements.

B. Operate each vehicle lift and demonstrate procedure for starting and stopping prior to its acceptance.

3.4 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 3 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable accessories.

END OF SECTION 144500

SECTION 146010 - HOISTS AND CRANES

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes:

1. Monorail type hoist systems.
2. Overhead crane, complete hoist system, connections and accessories.

B. Related CSI Section:

1. Division 05 Section 051200, "Structural Steel Framing." for coordination with steel to which the suspended overhead track system shall be attached.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include rated capacities of selected model clearly indicated, furnished specialties and accessories, wiring diagrams and installation instructions.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: Include construction details of the hoist and crane system and the crane support structure showing plan, elevation and sectional views along with other pertinent data as detailed by the manufacturer.

D. Quality Assurance Submittals:

1. Design data, including safety factor of materials
2. Certificate and Test report of each hoist and crane
3. Test reports of the hoists
4. Test reports of the crane system.

E. Maintenance Data: Include complete operating and maintenance instructions for each component of the crane system specified in Form 818 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

F. Warranties: As specified within this Section.

1.3 REFERENCES:

A. ANSI MH 27.1, Specifications for Underhung Cranes and Monorail Systems.

B. ANSI B30.16 Safety Standard for Overhead Hoists.

C. ANSI B30.11 Safety Standards for Monorails and Underhung Cranes.

D. ASME HST-4M, Performance Standard for Overhead Electric Wire Rope Hoists.

E. AWS D1.1, Code for Welding in Building Construction.

F. OSHA 29 CFR 1910.179, Overhead and Gantry Cranes.

G. CMAA No. 74 - Crane Manufacturers Association of America.

H. NEMA - National Electrical Manufacturers Association.

I. NEC - National Electrical Code.

1.4 QUALITY ASSURANCE:

A. Service Class; Equipment shall be meet the requirements for Class C in accordance with CMAA standards, under operation in normal ambient temperatures and normal indoor conditions, free from excessive dust, moisture and corrosive fumes.

B. Letter crane rated capacities on the bridge rail and on the control box.

C. Clearly label monorails to indicate maximum capacity. Letter crane rated capacities on the bridge rail and on the control box.

D. System Marking: Major components of the system shall be marked at the factory to assure prompt and proper field identification.

E. Secure the services of a factory-authorized service representative for the following:

1. Render advice regarding installation of the hoist and crane system.
2. Witness final system test and then certify with an affidavit that the hoist and crane system is installed in accordance with the Contract and is operating properly.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Equipment shall be protected against damage during shipment.

1.6 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of hoists and cranes that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from the issuance of the Certificate of Compliance.

1.7 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spare parts shall be furnished as recommended by the equipment manufacturer.

PART 2 - PRODUCTS

2.1 MONORAILS:

A. Monorail system capacity shall be a minimum of 3 tons. Wire rope shall have 3 ton weight limit.

1. Basis of Design: Product – Speedway, The New Century Series, Series 31 monorail hoist, Model # C1W03D021-15*2DO as supplied by Wright, Acco, or an approved equal.

B. Track shall be a specially fabricated section with a special rolled bottom section having a raised flat tread with a minimum bottom flange width of 3 inches. Bottom flange shall have a minimum ultimate tensile strength of 125,000 psi with a minimum Briell hardness of 225. Track shall be straight, with factory prepared ends. No rough-cut ends will be permitted. Holes shall be factory punched or drilled.

1. Basis of Design: Product – SUPERTRACK as supplied by Louden (Wright, Acco), or an approved equal.
2. Track size based on the load positioned on the track system to produce the most severe conditions of stress and deflection.
3. The total track deflection shall not exceed 1/450 of the span or 1-1/4 inch, whichever is the least.
4. Track sections shall be installed with bolted type splice plates to provide flush and level connections at the operating tread of the track. The maximum gap between the adjacent ends of the load carrying flange not to exceed 1/16 inch.

5. Rigid track support shall be accomplished by bolting the runway track to the supporting structure.
6. Track Suspension: All necessary clamps, hanger rods, bolts, and other fittings from which the track system is suspended shall be provided as a part of the overhead track system. Track hanger supports shall be spaced as shown on the Shop Drawings.

C. Hoists, trolleys, track switches, track and suspension fittings shall be painted one shop coat of manufacturer's standard finish; color to be selected by the Designer.

D. Bolts or hanger rods shall be painted after the installation of the monorail system is complete with a compatible paint coat. Paint shall also be used for touch up work for the monorail system.

E. Hoists and appurtenances shall be engineered to withstand stresses imposed under safe operating conditions while handling load with the rated capacity. Load bearing parts shall be designed such that the static stress, calculated for rated load, shall not exceed 20 percent of the ultimate strength of the material.

F. Electric hoists are to be furnished complete with a suitable pushbutton. Control station. Pushbutton arrangement is to be supplied with strain relief protection. Control actuators shall be dead-man type with speed adjustment of multi-speed control obtainable by progressive depression of the pushbutton elements to increase lift speed and spring return to off position.

G. Braking system shall be capable under normal operating conditions with rated load to stop and hold the load when controls are released. Controlled lowering shall be lifted to 120 percent of rated lowering speed. In the event of complete power failure; the load shall be stopped and held.

H. Bearings shall be heavy duty, anti-friction type with a minimum B-10 life of 5,000 hours. Where applicable, motor bearing shall be lifetime lubricated, sealed ball bearings.

I. Gears shall be forged heat treated alloy steel machined for smooth quiet operation. Gears shall meet AGMA qualify specifications. No cast gears shall be permitted.

J. Bottom block shall be completely shrouded for safety and fabricated from steel. Sheaves must be forged or rolled steel, running on anti-friction bearings. Hooks are to be forged steel supported by anti-friction thrust bearings and permit 360 degree rotation. Hooks shall be equipped with latches unless the application makes the use of the latch impractical.

K. When required, a latch shall be provided to bridge the opening of the hook for underslack conditions.

L. Motors shall be totally enclosed specifically designed for hoist service capable of stag and operating under any condition with the designed capacity and provided with thermal overload protection.

1. Electric hoists shall incorporate an upper plugging type limit switch automatically stopping the hoist motion when the block reaches its highest position. Excessive hook drift shall cause the block to be momentarily reversed.

M. Electric hoist controls shall comply with NEC requirements for the application being considered and shall include control circuit and contactors mechanically and electrically interlocked.

N. Provide double reeved electric wire rope hoist capable of lifting a minimum of 3 tons.

O. Hoists are to be furnished with a suitable push button control station. Push button arrangement is to be supplied with strain relief protection.

P. Hoist shall be reeved to allow true vertical lift.

Q. Hoist shall be capable of two lift speeds, the greater of which shall not exceed 21 feet per minute. A three to one reduction ratio shall be used.

R. Rigid enclosed conductor bar system may be web mounted or downturned, as applicable. Power circuits must have individual conductor bars and collectors shall conform to the description listed in Part 2.3.

S. Push button pendent shall be suspended from an independent trolley track to allow the operator to move away from the load being lifted. The pendent station shall be able to travel freely across the trolley track.

T. Motorized trolley shall be an integral part of the hoist system. Trolley shall have a single speed and be capable of traveling at a rate of 50 fpm.

2.2 CRANE SYSTEMS:

A. Top running overhead motorized crane system conforming to CMAA standards, Class C Service, with beams, supports and accessories necessary for a complete functional installation.

1. Basis of Design: 3 ton bridge crane as supplied by a CraneMart Dealer using a Shaw-Box Hoist, or an approved equal.

B. Crane Bridge: Single girder, top-running, dual (individual) drive structure comprised of the girder, end trucks, drive units, and control panel and electrification system. The bridge shall be designed and fabricated as a complete integral structure with only such parts removable as required to facilitate the erection and maintenance of equipment.

Crane span shall be as indicated on the Plans. Bridge travel shall be single speed, a minimum of 75 feet per minute.

1. Bridge girder shall be constructed of standard structural shapes or boxed sections, reinforced and welded as required. Connections between the girder and end trucks can be either welded or bolted after installation and squaring.
2. End trucks shall have a minimum wheelbase of 1/8 of the crane's span. Each end truck shall be carried on two (2) wheels running on anti-friction bearings. Wheels shall be of machined steel, hardened to 300 –320 BHN, double flanged and capable of running on either ASCE or square bar runway rails. The end trucks shall be provided with rubber bumpers at each end to engage end stops on the crane runway.
3. The rated capacity of the crane shall be the load that the crane is designed to carry as specified by the manufacturer and shown in tons on large capacity plates located on each side of the crane bridge. The crane bridge shall be designed and built to handle this rated load plus the weight of the hoist, trolley and all handling accessories such as buckets, magnets, grabs, etc., shall be included as part of the load to be handled.
4. Materials shall be properly selected for the stresses to which they will be subjected. Load carrying parts, except girders shall be designed so that the calculated static stress in the material, based on rated load, shall not exceed 20 percent of the published average ultimate strength of the material. This limitation of stress provides a margin of strength to allow for variations in the properties of materials and under no condition should imply authorization or protection for user to load the crane beyond capacity. Girders shall be designed in accordance with CMAA No. 74 Specifications.
5. All materials shall be free from all defects and imperfections that may affect the finished product. All parts shall be unused.
6. Structural steel shall conform to ASTM specification A36.
7. End trucks shall be fabricated from tubes, structural steel shapes and plates welded into an integral unit and in-line bored to receive the wheel axles.
8. Bearings shall be anti-friction ball or roller type, oil splash lubricated or equipped with easily lubrication fittings.

C. Bridge Drive: Crane bridge shall be driven by two drives. One located on and driving one wheel on each end truck. Each drive shall consist of a drive gear reducer, a TENV, crane duty, 30 minute rated motor with class F insulation and means of braking to meet the requirements of OSHA.

D. Bridge Control Panel: The bridge motion's control shall be located in a bridge-mounted NEMA Type 1 enclosure. The bridge control is to be provided with a mainline contactor controlled from the bridge control station and a door-mounted disconnect that turns off power to the bridge panel and drives and the hoist and trolley panel and drives before the panel door can be opened.

E. Crane Motion Control: All motions of the crane (hoist, trolley and bridge) shall be operated through a single cable suspended pendant pushbutton type control. The pendant shall have two buttons for the control of each motion plus power on/off buttons.

1. Pushbutton station shall be of molded contour grip type and supported from hoist by strain relief cable to avoid damage from pull on the control wires. The enclosure is to be NEMA Type 1. Controls pendant shall be 115 volt AC, supported by a strain cable. Pendant shall hang to a point 3' - 6" above the operating floor elevation. The pushbuttons shall return to the off position when the operator releases the pressure. The magnetic contactors for all motions shall be mechanically or electrically interlocked. Control voltage at the pushbutton stations shall be grounded to the hoists. A strain reliever cable shall support the control pendant.

F. Crane Bridge Electrification: The bridge shall be provided with a main power pick-up (collector pole) and sliding shoe collectors that shall contact and run in the shielded bar runway conductor system. Power and control voltage shall be provided to the moving trolley and hoist through means of a festoon flat cable system. There shall be separate cables for the motor power supply (line voltage) and control and these cables shall be provided with separate connecting fittings and plugs. The cable connecting fittings and plugs shall be metal, not plastic, and shall be easily repairable or modified in the field without special tools. The power and control cables shall be carried from trolleys with four (4) steel wheels running in a track suspended off of the bridge girder running the full length of the crane span.

G. Crane Runway System:

1. Runway beams shall be provided as indicated on the Plans and installed conforming to CMAA standards.
2. ASCE runway rails shall be provided and installed on the runway beams. The rails shall be properly sized for the crane's intended service class, wheel diameter and loading and are to be secured to the top of the runway beams with J-bolts to permit future adjustments as needed. Bolted rail splices shall be used to join the ends of the rail together and end stops shall be provided at each end of the rails to engage with the bridge end truck bumpers.
3. Runway power electrification shall be provided running the full length on one side of the runway. The electrification will be of the shielded bar type supported at proper intervals to prevent sag or excessive vibration and with power feeds located to minimize voltage drop so as to provide adequate power to operate at least the hoist and one traverse motion at the extreme ends of the runway.

H. Electric Wire Rope Hoist and Trolley: Double reeved electric motor-operated wire rope hoist and trolley capable of lifting 3 tons. Hoist shall be capable of two lift speeds, the greater of which shall not exceed 20 feet per minute. Motorized trolley shall be integral

part of the hoist system and shall have a single speed of and capable of traveling at a rate of 50 feet per minute.

1. Frame shall be fabricated from rolled steel to form a one-piece weldment.
2. Gear case is to be machined aluminum alloy casting with sealed construction allowing the gears and load brake to operate in a bath of oil.
3. Bearings shall be high quality anti-friction type of either needle or ball design and used throughout the hoist. Bearings, not considered lifetime lubricated by the manufacturer, should be provided with a means for lubrication.
4. Hoist shall have (2) types of brakes: One DC electrical multiple disc motor brake spring set electrically released, and one self-adjusting Weston type mechanical load brake located in the gear case. Either brake shall have the capability of holding rated load in the event of failure of either brake system.
5. Motors shall be of high starting torque type designed specifically for hoist duty service with permanently lubricated ball bearings, rated for 30-minute duty cycle. The motor enclosure shall be TENV. Motor insulation shall be class F minimum. The high speed to low speed ratio shall be 3:1. Motor is to have automatic reset temperature actuated switch in motor windings to provide motor running over current protection.
6. Deep grooved, large diameter rope drum that helps prevent over wrap of cable for longer rope life.
7. An upper block operated control circuit limit switch shall be provided that shuts off the hoist motor when the load hook reaches its highest position.
8. Controls to be centralized and housed in a panel with a hinged door. The controls shall be provided with a step-down transformer within the panel that provides 120 volts power to the control circuits. Control circuit voltage to the push button station shall not exceed 120 volts.
9. Motor driven trolleys shall have heavy section rolled steel side frames and the wheels shall be steel with heat-treated (universal/patented track) tread. Motor driven trolleys shall have TENV motors with right angle gear reducers. The wheel gears and pinions shall have machined cut gear teeth. Spacer washers shall be provided for trolley adjustments to the beam.

I. Hoist and Trolley Electrification: Sizing and selection of electric motors shall be provided by the crane manufacturer. All motors shall be of the standard efficiency totally enclosed non-ventilated squirrel cage type and shall be of ample size and construction to carry continuously all loads, which may be imposed through their full range of operation. The maximum motor loading shall not exceed the nameplate horsepower rating, exclusive of service factor and all motors shall operate at speeds not greater than that described herein.

J. Electrical Requirements: Furnish, mount and wire fused, manual disconnect switch with a lockable handle mounted through the panel door; including wiring from disconnect switch to the conductor bars. Location shall be as directed by the Engineer. Equipment shall be able to operate from 208V, 3 phase, 60 Hz power source.

K. Paint: Manufacturer's standard paint system.

2.3 ELECTRICAL REQUIREMENTS:

A. Conductor bar shall be UL approved, roll formed electro-galvanized steel sections, rated 100 amps continuous. Insulation cover shall be rigid bright red PVC, self-extinguishing, with an operating temperature of 1500 F.

B. Conductors shall be complete with mounting clips, end caps, splices with covers and power feeds.

C. Current collectors shall be the sliding shoe type; spring loaded and designed that sparking and loss of contact will be minimized.

D. Separate conductors shall be provided for each phase. More than one conductor in a single enclosure will not be permitted.

E. Furnish, mount and wire fused, manual disconnect switch with a lockable handle mounted through the panel door; including wiring from disconnect switch to the conductor bars. Location shall be as directed by the Engineer.

F. Equipment shall be able to operate from 208V, 3 phase, 60 Hz power source.

G. Motors equipped with magnetic contactors operated with ON-OFF push button station pendant suspended 4'-0" above the floor, from the hoist trolley unit tors equipped with magnetic contactors operated with ON-OFF push button station pendant suspended 4'-0" above the floor, from the hoist trolley unit

H. Electrical equipment shall meet NEMA 1 requirements.

I. Control circuits: Maximum 120 volts.

J. Provide Interlocks where necessary for proper operation:

K. The interlock mechanism shall be manually operated, cross-connected, double locking pin type so designed that they will not operate until the crane is in proper alignment with the connecting crossover or spur rail.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Material shall be cleaned of loose rust, mill scale and foreign matter prior to shop painting.

B. Verify that conditions are in accordance with manufacturer's requirement prior to installation.

3.2 INSTALLATION:

A. Install hoists and cranes in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL:

A. Hoists and cranes shall be load tested in accordance with manufacturer's requirements.

B. Operate each hoist and crane and demonstrate procedure for starting and stopping prior to its acceptance.

3.4 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 3 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable accessories.

END OF SECTION 146010

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES:

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CALPICO, Inc.

2. Metraflex Company (The).

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Plastic.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION:

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in CSI Division 07 Section 079200, "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply

with requirements for firestopping specified in CSI Division 07 Section 078413, "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION:

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE:

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.
b. Piping NPS 6 and Larger: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

3.4 GROUT:

A. Refer to CSI Division 03 Section 033000, "Cast in Place Concrete" for non-shrink grout.

END OF SECTION 210517

SECTION 211119 – FIRE DEPARTMENT CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Exposed-type fire-department connections.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.
2. Obtain and include in submittal a written document from the local fire department confirming the type and size of the FDC to be provided.

PART 2 - PRODUCTS

2.1 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Elkhart Brass Mfg. Company, Inc.
2. Fire-End & Croker Corporation.
3. Guardian Fire Equipment, Inc..

B. Standard: UL 405.

C. Type: Exposed, projecting, for wall mounting.

D. Pressure Rating: 175 psig minimum.

E. Body Material: Corrosion-resistant metal.

F. Inlets: As required by the local fire department.

G. Caps: As required by the local fire department.

H. Escutcheon Plate: Round, brass, wall type.

I. Outlet: Back, with pipe threads.

J. Number of Inlets: As required by the local fire department.

K. Escutcheon Plate Marking: Similar to "AUTO SPKR."

L. Finish: Rough brass or bronze.

M. Outlet Size: NPS 6.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Install wall-type fire-department connections.

B. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION 211119

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Backflow preventers.
4. Fire-department connections.
5. Sprinklers.
6. Alarm devices.
7. Pressure gages.

1.2 DEFINITIONS:

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.3 SYSTEM DESCRIPTION:

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.4 PERFORMANCE REQUIREMENTS:

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Available fire-hydrant flow test records indicate the following conditions:

a. Date: January 8, 2020.
b. Performed by: Town of Putnam.

Location of Fire Hydrant: Intersection of Industrial Park Rd and Killingly Ave; at DOT Facility entrance.

1) Static Pressure: 100 psig.
2) Flow Pressure: 75 psig.
3) Measured Flow: 1455 gpm.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: A minimum of 10 psi, or 10%, whichever is more stringent, safety margin shall be maintained between the available water supply and the combined demand of the sprinkler system and hose stream allowance.

2. Sprinkler Occupancy Hazard Classifications:

   a. Repair Bay Areas: FM Hazard Category 3.
   b. Mechanical, Electrical, Sprinkler Rooms: FM Hazard Category 2.
   c. Office Areas: FM Hazard Category 1.
   d. Stores Stockroom: On-Tread Tire Storage Less Than 10 ft. High.

3. Minimum Density for Automatic-Sprinkler Piping Design:

   a. FM Hazard Category 1: 0.10 gpm/sq. ft. over 1500-sq. ft. area, in accordance with FMG Data Sheet 3-26.
   b. FM Hazard Category 2: 0.20 gpm/sq. ft. over 2500-sq. ft. area, in accordance with FMG Data Sheet 3-26.
   c. FM Hazard Category 3: 0.30 gpm/sq. ft. over 2500-sq. ft. area, in accordance with FMG Data Sheet 3-26.
   d. On-Tread Tire Storage Less Than 10 ft. High: 0.60 gpm/sq. ft. over 3000-sq. ft. area, in accordance with FMG Data Sheet 8-3.

4. Maximum Protection Area per Sprinkler:

   a. According to the more restrictive recommendations of FMG Data Sheet 2-0 and NFPA 13, unless otherwise indicated.

5. Total Combined Hose-Stream Demand Requirement: According to the more restrictive recommendations of FMG Data Sheets 2-0, 3-26, 7-32, 8-3 and NFPA 13, unless otherwise indicated:

   a. FM Hazard Category 1: 250 gpm.
   b. FM Hazard Category 2: 250 gpm.
   c. FM Hazard Category 3: 500 gpm.
   d. On-Tread Tire Storage Less Than 10 ft. High: 500 gpm.

6. Quick Response Sprinklers: FM Global does NOT subscribe to any Reduction in Area Methods associated with Quick-Response sprinklers.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to the more restrictive recommendations of FMG Data Sheet 2-0, 2-8, and NFPA 13, as well as ASCE/SEI 7.

1.5 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Include Sprinkler Identification Numbers (SIN).
2. All components shall be FM Approved as currently listed in the FM Global Approval Guide. This is available at www.fmglobal.com and is listed as Volume 1, Chapter 1.
3. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Working Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

D. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Items penetrating finished ceiling include the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Fire Alarm System Smoke and Heat Detectors.
e. Occupancy Sensors.

F. Quality Assurance Submittals:

1. Qualification Data: Provide copies of licenses for qualified Installer and professional engineer.

G. Approved Sprinkler Piping Drawings: Working plans, prepared according to the more restrictive recommendations of FMG Data Sheet 2-0 and NFPA 13 that have been approved by authorities having jurisdiction, including hydraulic calculations.

H. Welding certificates.

I. Fire-hydrant flow test report.

J. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in FMG Data Sheet 2-0 and NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

K. Field quality-control reports.

L. Maintenance Data: For sprinkler specialties to include in operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE:

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following unless referenced FM Global Standards include more stringent requirements:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

E. FM Global Standards (available at www.fmglobal.com):

1. Data Sheet 2-0, “Installation Guidelines for Automatic Sprinklers.”

2. Data Sheet 2-8, “Earthquake Protection for Water-Based Fire Protection Systems.”
3. Data Sheet 3-10, “Installation and Maintenance of Private Fire Service Mains and Their Appurtenances.”

1.7 COORDINATION:

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.8 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by the more restrictive of FMG Data Sheet 2-0 and NFPA 13, and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

A. Comply with requirements in Part 3.12, "Piping Schedule" for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS:

A. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Galvanized and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.

D. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

I. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.
b. Shurjoint Piping Products.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.

2. Pressure Rating: 175 psig minimum.
3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

J. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Victaulic Company.

2.3 DUCTILE-IRON PIPE AND FITTINGS:

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.

a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 PIPING JOINING MATERIALS:

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 LISTED FIRE-PROTECTION VALVES:

A. General Requirements:

1. Valves shall be FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.
b. Victaulic Company.

2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Iron Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.
b. Milwaukee Valve Company.
c. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

D. Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AFAC Inc.
   b. Anvil International, Inc.
   c. Crane Co.; Crane Valve Group; Crane Valves.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Victaulic Company.

2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

E. Iron OS&Y Gate Valves

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. Shurjoint Piping Products.
   e. Tyco Fire & Building Products LP.

2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

F. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.
b. Fivalco Inc.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Shurjoint Piping Products.
f. Tyco Fire & Building Products LP.
g. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:

a. Valve Type: Ball or butterfly.
b. Body Material: Bronze.
c. End Connections: Threaded.

5. Valves NPS 2-1/2 and Larger:

a. Valve Type: Butterfly.
b. Body Material: Cast or ductile iron.
c. End Connections: Flanged, grooved, or wafer.

6. Valve Operation: Integral visual indicating device.

2.6 TRIM AND DRAIN VALVES:

A. General Requirements:

1. Standard: "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Tyco Fire & Building Products LP.
e. Victaulic Company.

2.7 SPECIALTY VALVES:

A. General Requirements:

1. Standard: "Approval Guide," published by FM Global, listing.
2. Pressure Rating:

   a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AFAC Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber (if water supply pressure is not constant), and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping if a retarding chamber is provided; otherwise pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AFAC Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.

2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.8 BACKFLOW PREVENTERS:

A. Double-Check, Backflow-Prevention:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Conbraco Industries, Inc.
   b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1015 or AWWA C510.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: Full size of connecting piping.
6. Body: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved, steel with interior lining that complies with AWWA C550 or that is FDA approved, or stainless steel.
7. End Connections: Flanged.
8. Configuration: Designed for horizontal, straight-through flow.
9. Accessories:

   a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

2.9 FIRE-DEPARTMENT CONNECTIONS:

A. Exposed-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.
   c. Fire-End & Croker Corporation.
   d. Tyco Fire & Building Products LP.

2. Standard: UL 405.
3. Type: Exposed, projecting, for wall mounting.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.

6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Locking caps complying with Putnam Fire Department standards.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Two 2-1/2-inch
11. Escutcheon Plate Marking: Similar to "AUTO SPKR."
12. Finish: Rough brass or bronze.
13. Outlet Size: NPS 6.

2.10 SPRINKLER SPECIALTY PIPE FITTINGS:

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anvil International, Inc.
   b. Shurjoint Piping Products.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.

2. Standard: "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.

2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Tyco Fire & Building Products LP.
   b. Victaulic Company.
   c. Viking Corporation.

2. Standard: "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. CECA, LLC.
   b. Merit Manufacturing; a division of Anvil International, Inc.

2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.

4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Fivalco Inc.
   b. FlexHead Industries, Inc.
   c. Gateway Tubing, Inc.

2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.11 SPRINKLERS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFAC Inc.
2. Reliable Automatic Sprinkler Co., Inc.
3. Tyco Fire & Building Products LP.
4. Victaulic Company.
5. Viking Corporation.

B. General Requirements:

1. Standard: "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6 for HC-1, 8.0 for HC-2 and 11.2 for HC-3, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.

E. Special Coatings:

1. Wax.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Reliable Automatic Sprinkler Co., Inc.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.12 ALARM DEVICES:

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fire-Lite Alarms, Inc.; a Honeywell company.
b. Notifier; a Honeywell company.
c. Potter Electric Signal Company.

2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 10-inch diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Potter Electric Signal Company.
   b. System Sensor; a Honeywell company.
   c. Viking Corporation.

2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AFAC Inc.
   b. Potter Electric Signal Company.
   c. System Sensor; a Honeywell company.
   d. Tyco Fire & Building Products LP.

2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.

2. Standard: UL 346.

3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.13 PRESSURE GAGES:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Perform fire-hydrant flow test according to the more restrictive recommendations of FMG Data Sheet 2-0 and NFPA 13, and NFPA 291. Use results for system design calculations required in Part. 1.6, "Quality Assurance."

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING:

A. Extend fire suppression service piping to a point 5-feet off the outside of the foundation wall for connection to exterior water distribution piping in sizes and locations indicated. Connect sprinkler piping to fire suppression service piping for service entrance to building. Refer to Item #1301082A, “8” Ductile Iron Pipe (Water Main)” for exterior water distribution piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.3 PIPING INSTALLATION:

A. Locations and Arrangements: Plans indicate general location and arrangement of piping and sprinkler heads for illustrative purposes of required coverage only. The Contractor shall locate piping and sprinklers as required by its design.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Designer before deviating from approved working plans.

B. Piping Standard: Comply with the more restrictive requirements for installation of sprinkler piping in FMG Data Sheet 2-0 and NFPA 13.

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install seismic restraints on piping. Comply with the more restrictive requirements for seismic-restraint device materials and installation in FMG Data Sheet 2-0, NFPA 13 and ASCE/SEI 7.

E. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

F. Install unions adjacent to each valve in pipes NPS 2 and smaller.

G. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

H. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to the more restrictive requirements of FMG Data Sheet 2-0 and NFPA 13.

I. Install sprinkler piping with drains for complete system drainage.

J. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

K. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

L. Install alarm devices in piping systems.

M. Install hangers and supports for sprinkler system piping according to the more restrictive requirements of FMG Data Sheet 2-0 and NFPA 13. Comply with the more restrictive requirements for hanger materials in FMG Data Sheet 2-0 and NFPA 13.

N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated ball valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

O. Fill sprinkler system piping with water.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in CSI Division 21 Section 210517, "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in CSI Division 21 Section 210517, "Sleeves and Sleeve Seals for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION:

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to Part 1.6, "Quality Assurance."

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION:

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to the more restrictive requirements of FMG Data Sheet 2-0 and NFPA 13, and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

E. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

F. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

G. Do not install bypass piping around backflow preventers.

3.6 SPRINKLER INSTALLATION:

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION:

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.8 IDENTIFICATION:

A. Install labeling and pipe markers on equipment and piping according to CSI Division 22 Section 220553, "Identification for Plumbing Piping and Equipment."

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section 260533, "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL:

A. Perform tests and inspections in the presence of the Engineer, the authority having jurisdiction, and FMG.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to FMG Data Sheet 2-0 and NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 CLEANING:

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.11 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.12 PIPING SCHEDULE:

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Under-building-slab, fire suppression, building-service piping, included in the MLSI, NPS 4 and larger, shall be the following:

1. Mechanical-joint, ductile-iron pipe; standard- or compact- pattern mechanical-joint fittings; and mechanical joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

E. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, black-steel pipe with cut- or roll-]rooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

F. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

3.13 SPRINKLER SCHEDULE:

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Pendent sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Special Applications: Extended coverage, quick-response sprinklers for Light Hazard applications.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

C. Provide sprinkler guards for all sprinklers in the Mechanical Room, Electrical Room, Communications Room, and the Sprinkler Room.

END OF SECTION 211313

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Pipe loops and swing connections.
2. Alignment guides and anchors.

1.2 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Delegated-Design Submittal: For each anchor and alignment guide 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. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Welding certificates.

1.5 QUALITY ASSURANCE:

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 ALIGNMENT GUIDES AND ANCHORS:

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Adsco Manufacturing LLC.
b. Advanced Thermal Systems, Inc.
c. Flexicraft Industries.
d. Hyspan Precision Products, Inc.
e. Metraflex, Inc.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

a. Stud: Threaded, zinc-coated carbon steel.
b. Expansion Plug: Zinc-coated steel.
c. Washer and Nut: Zinc-coated steel.

5. Concrete and Grout: Comply with requirements in CSI Division 03 Section 033000, "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.

PART 3 - EXECUTION

3.1 PIPE LOOP AND SWING CONNECTION INSTALLATION:

A. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.

B. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

C. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.2 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION:

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one or two guides on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES:

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 SLEEVE-SEAL SYSTEMS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CALPICO, Inc.
2. Metraflex Company (The).

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Plastic.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION:

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in CSI Division 07 Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in CSI Division 07 Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION:

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE:

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.
b. Piping NPS 6 and Larger: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:

a. Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Interior Partitions:

a. Galvanized-steel-pipe sleeves.

3.4 GROUT:

A. Refer to CSI Division 03 Section 033000 “Cast in Place Concrete” for non-shrink grout.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Escutcheons.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS:

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

D. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
c. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

3.2 FIELD QUALITY CONTROL:

A. Replace broken and damaged escutcheons using new materials.

END OF SECTION 220518

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.

B. Related CSI Sections:

1. Division 22 Section 221116 "Domestic Water Piping" for water meters inside the building.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Product Certificates: For each type of meter and gage, from manufacturer.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS:

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Trerice, H. O. Co.

b. Weiss Instruments, Inc.
c. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum, copper-plated steel, or brass and of length to suit installation.

   a. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS:

A. Manufacturers: Same as manufacturer of thermometer being used.

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES:

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Trerice, H. O. Co.

b. Weiss Instruments, Inc.
c. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS:

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Sisco Manufacturing Company, Inc.
2. Trerice, H. O. Co.
3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Self-sealing rubber.

1. Insert material for water service at 20 to 200 deg F shall be chlorosulfonated polyethylene synthetic.
2. Insert material for water service at minus 30 to plus 275 deg F shall be EPDM.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids.

H. Install test plugs in piping tees.

I. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.

J. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS:

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING:

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE:

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE:

A. Scale Range for Domestic Water Piping: 0 to 100 psi.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Bronze ball valves.
2. Bronze lift check valves.
3. Bronze swing check valves.
4. Bronze gate valves.

B. Related CSI Sections:

1. Division 22 Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Division 22 Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
3. Division 22 Section 221513 "General-Service Compressed-Air Piping" for valves applicable only to this piping.

1.2 DEFINITIONS:

A. CWP: Cold working pressure.

B. NRS: Nonrising stem.

C. SWP: Steam working pressure.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of valve indicated.

1.4 INFORMATIONAL SUBMITALLS:

A. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.5 QUALITY ASSURANCE:

A. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Refer to Form 818 Article 1.06.03 and Form 818 Article 1.20-1.06.03 for additional information.

B. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Block check valves in either closed or open position.
5. Set gate valves closed to prevent rattling.

C. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES:

A. Refer to Part 3 valve schedules for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Vinyl-Covered Handlever: For quarter-turn valves NPS 6 and smaller.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Solder Joint: With sockets according to ASME B16.18.
2. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES:

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. NIBCO INC.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

2.3 BRONZE LIFT CHECK VALVES:

A. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Flo Fab Inc.
    b. NIBCO INC.
    c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 2.
    b. CWP Rating: 200 psig.
    c. Body Design: Vertical flow.
    d. Body Material: ASTM B 61 or ASTM B 62, bronze.
    e. Ends: Threaded.
    f. Disc: NBR, PTFE, or TFE.

2.4 BRONZE SWING CHECK VALVES:

A. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Stockham Division.
    c. NIBCO INC.
    d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 4.
    b. CWP Rating: 200 psig.
    c. Body Design: Horizontal flow.
    d. Body Material: ASTM B 62, bronze.
    e. Ends: Threaded.
    f. Disc: PTFE or TFE.

2.5 BRONZE GATE VALVES

A. Bronze Gate Valves, NRS, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. NIBCO INC.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: Bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION:

A. Install valves with unions at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING:

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS:

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball valves.
2. Throttling Service: Ball valves.
3. Pump-Discharge: Check Valves.

a. NPS 2 and Smaller: Bronze swing check valves with nonmetallic disc.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS):

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Lift Check Valves: Class 125, nonmetallic disc.
4. Bronze Swing Check Valves: Class 125, nonmetallic disc.

3.6 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE:

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125, nonmetallic disc.
4. For wash bay 1-1/2-inch hose fittings: Bronze gate valves, NRS, Class 125 with soldered or threaded ends.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.

B. Related CSI Sections:

1. Division 05 Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 22 Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.2 DEFINITIONS:

A. Terminology: As defined in MSS SP-90, “Guidelines on Terminology for Pipe Hangers and Supports,” Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.3 PERFORMANCE REQUIREMENTS:

A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

1.4 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Welding certificates.

1.6 QUALITY ASSURANCE:

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 STEEL PIPE HANGERS AND SUPPORTS:

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3.5 “Hanger and Support Schedule” for specific hanger and support applications.

B. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

E. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS:

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS:

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS:

A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS:

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION:

A. Steel Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 METAL FABRICATIONS:

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.3 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING:

A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 Painting Sections.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE:

A. Specific hanger and support requirements are in CSI Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

3. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
2. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
3. C-Clamps (MSS Type 23): For structural shapes.
4. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.

L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes vibration and seismic controls for plumbing piping and equipment.

B. Related CSI Requirements:

1. Division 23 Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.2 DEFINITIONS:

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
5. Seismic-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Qualification Data: For professional engineer and testing agency.
2. Welding certificates.
3. Field quality-control reports.

1.5 QUALITY ASSURANCE:

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: Refer to Structural Drawing No. S-002.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: Refer to Drawing No. S-002.

    a. Seismic Design Category: Refer to Structural Drawing No. S-002.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): Refer to Structural Drawing No. S-002.
4. Design Spectral Response Acceleration at 1.0-Second Period: Refer to Structural Drawing No. S-002.
5. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

    a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.2 ELASTOMERIC ISOLATION PADS:

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Ace Mountings Co., Inc.
    b. Isolation Technology, Inc.
    c. Vibration Mountings & Controls, Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Load-bearing metal plates adhered to pads.

2.3 ELASTOMERIC ISOLATION MOUNTS:

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Ace Mountings Co., Inc.
    b. Isolation Technology, Inc.
    c. Vibration Mountings & Controls, Inc.

2. Mounting Plates:

    a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
    b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS:

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Ace Mountings Co., Inc.
    b. Isolation Technology, Inc.

c. Vibration Mountings & Controls, Inc.

2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

a. Housing: Cast-ductile iron or welded steel.
b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS:

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. Isolation Technology, Inc.
c. Vibration Mountings & Controls, Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 RESTRAINED-SPRING ISOLATORS:

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. Isolation Technology, Inc.
c. Vibration Mountings & Controls, Inc.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

    a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Top plate with threaded mounting holes or elastomeric pad.
    c. Internal leveling bolt that acts as blocking during installation.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 PIPE-RISER RESILIENT SUPPORT:

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.8 RESILIENT PIPE GUIDES:

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.9 ELASTOMERIC HANGERS:

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Ace Mountings Co., Inc.

b. Isolation Technology, Inc.
c. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.10 SPRING HANGERS:

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. Mason Industries, Inc.
c. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.11 SNUBBERS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Kinetics Noise Control, Inc.

2. Mason Industries, Inc.
3. Vibration Mountings & Controls, Inc.

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

2.12 RESTRAINT CHANNEL BRACINGS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.13 RESTRAINT CABLES:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Kinetics Noise Control, Inc.
2. Loos & Co., Inc.
3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.14 SEISMIC-RESTRAINT ACCESSORIES:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. TOLCO.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.15 ADHESIVE ANCHOR BOLTS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.16 VIBRATION ISOLATION EQUIPMENT BASES:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. California Dynamics Corporation.
2. Kinetics Noise Control.
3. Mason Industries.
4. Vibration Eliminator Co., Inc.
5. Vibration Isolation.
6. Vibration Mountings & Controls, Inc.

B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-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.

3.2 APPLICATIONS:

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION:

A. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

B. Equipment Restraints:

1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.

2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION:

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in CSI Division 22 Section 221116 "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL:

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with the Engineer before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Engineer's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by the Engineer.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING:

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 PLUMBING VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE:

A. Supported Equipment: Water Heater.

1. Equipment Location: Mechanical Room.
2. Type: As required.
3. Minimum Deflection: As required.
4. Component Importance Factor: 1.5.
5. Component Response Modification Factor: 2.5.
6. Component Amplification Factor: 1.0.

B. Supported Equipment: Air Compressor, Aftercooler, Air Dryer.

1. Equipment Location: Compressor Room.
2. Pads:

   a. Material: Neoprene, Rubber, or Hermetically sealed compressed fiberglass.
   b. Thickness: As required.
   c. Number of Pads: As required.

3. Mount: Elastomeric
4. Isolator Type: Restrained Spring Isolator.
5. Minimum Deflection: As required.
6. Component Importance Factor: 1.5.
7. Component Response Modification Factor: 2.5.
8. Component Amplification Factor: 2.5.

C. Suspended Equipment: Water Heater Expansion Tank.

1. Equipment Location: Mechanical Room.
2. Isolator Type: As required.
3. Minimum Deflection: As required.
4. Component Importance Factor: 1.5.
5. Component Response Modification Factor: 2.5.
6. Component Amplification Factor: 2.5.

D. Suspended Equipment: Domestic Water Pump.

1. Equipment Location: Mechanical Room.
2. Isolator Type: Elastomeric Hangers, Spring Hangers, or Spring Hangers with Vertical Limit Stop.
3. Minimum Deflection: As required.
4. Component Importance Factor: 1.5.
5. Component Response Modification Factor: 2.5.
6. Component Amplification Factor: 1.0.

E. Piping Systems: Sanitary and Vent, and Storm.

1. Type: As required.
2. Minimum Deflection: As required.
3. Component Importance Factor: 1.5.

4. Component Response Modification Factor: 2.5.
5. Component Amplification Factor: 1.0.

F. Piping Systems, NPS 2 and smaller: Domestic Water, All Compressed Air.

1. Not required.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 CLOSEOUT SUBMITTALS:

A. Maintenance Data: Include valve schedules for each piping system to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE:

A. ASME Compliance: Comply with ASME 13.1 “Scheme for the Identification of Piping Systems” for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION:

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS:

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Blue.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Plan designation or unique equipment number.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS:

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Plans, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS:

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance manual and shall be framed and mounted on the wall in the Mechanical Room at a location determined by the Engineer.

2.5 WARNING TAGS:

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION:

A. Install or permanently fasten labels on each major item of mechanical equipment and on each minor item of mechanical equipment as directed by the Engineer.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION:

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule: In accordance with ASME A13.1.

3.4 VALVE-TAG INSTALLATION:

A. Install tags on valves and control devices in piping systems as directed by the Engineer, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape: 2 inches, round.
2. Valve-Tag Color: Natural.
3. Letter Color: Black.

3.5 WARNING-TAG INSTALLATION:

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Storm-water piping exposed to freezing conditions.
5. Roof drains and rainwater leaders.
6. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related CSI Sections:

1. Division 23 Section 230719, "HVAC Piping Insulation."

1.2 DEFINITIONS:

A. ASJ: All Service Jacket.

B. SSL: Self Sealing Lap.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

1.4 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for

compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.5 QUALITY ASSURANCE:

A. Source Limitations: Obtain plumbing and HVAC insulation from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less, or FM Approved Class I materials.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION:

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in CSI Division 22 Section 220529, "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application.

1.8 SCHEDULING:

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS:

A. Comply with requirements in Part 3 Piping Schedules for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Micro-Lok.
b. Knauf Insulation; 1000-Degree Pipe Insulation.
c. Manson Insulation Inc.; Alley-K.
d. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in Part 2.5 "Factory-Applied Jackets".

2.2 ADHESIVES:

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS:

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.4 SEALANTS:

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FACTORY-APPLIED JACKETS:

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.6 FIELD-APPLIED JACKETS:

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.7 TAPES:

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.8 SECUREMENTS:

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. C & F Wire.

2.9 PROTECTIVE SHIELDING GUARDS:

A. Protective Shielding Pipe Covers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. 103 as manufactured by Truebro, Inc., or an approved equal.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements. Include manufacturer's standard fasteners, straps, and adhesives. Cover for stops and handles shall be removable. Color shall be white.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS:

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS:

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in CSI Division 07 Section 078413, "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in CSI Division 07 Section 078413, "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION:

A. Requirements herein generally apply to all insulation materials except where more specific requirements are specified elsewhere in this Section.

B. Insulation Installation on Fittings, Valves, Strainers, and Unions:

1. Install insulation over fittings, valves, strainers, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe

insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection and finish with finishing cement, mastic, and flashing sealant.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION:

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3.7 FIELD-APPLIED JACKET INSTALLATION:

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 PIPING INSULATION SCHEDULE, GENERAL:

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Underground piping.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.9 INDOOR PIPING INSULATION SCHEDULE:

A. Domestic Cold Water:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Refer to Part 2 of this Specification.

3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE:

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Exposed: Wash Bay.

1. PVC: 20 mils thick.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside the building to a point 5-feet off the outside of the foundation wall.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following:

1. Pipe, tube, and fittings.

1.3 INFORMATIONAL SUBMITTALS:

A. System purging and disinfecting activities report.

B. Quality Assurance Submittals:

1. Water Samples: Specified in Part 3.9, “Cleaning”.
2. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

A. Comply with requirements in Part 3.10 "Piping Schedule" for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS:

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.

2.3 PEX TUBE AND FITTINGS:

A. PEX Distribution System: ASTM F 877, SDR 9 tubing.

B. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.

2.4 PIPING JOINING MATERIALS:

A. Solder Filler Metals: ASTM B 32, lead-free alloys.

B. Flux: ASTM B 813, water flushable.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

D. Joints for PEX Piping: Join according to ASTM F 1807.

PART 3 - EXECUTION

3.1 EXCAVATION:

A. Refer to Form 818 Section 2.05, “Trench Excavation” for excavating, trenching, and backfilling requirements.

B. Excavation for domestic water piping within the building to a point 5-feet outside the foundation wall is included for payment in the Major Lump Sum Item (MLSI) for the Project. There will be no separate payment for excavation for domestic water piping.

3.2 PIPING INSTALLATION:

A. Extend domestic water service piping to a point 5-feet off the outside of the foundation wall for connection to exterior water distribution piping in sizes and locations indicated. Refer to Item #1301307A, “2” Copper Pipe (Type K)” for exterior water distribution piping.

B. Plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved by the Designer.

C. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in CSI Division 22 Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in CSI Division 22 Section 221119 "Domestic Water Piping Specialties."

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in CSI Division 22 Section 221119 "Domestic Water Piping Specialties."

G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in CSI Division 22 Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. Install piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping adjacent to equipment and specialties to allow service and maintenance.

N. Install piping to permit valve servicing.

O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

P. Install piping free of sags and bends.

Q. Install fittings for changes in direction and branch connections.

R. Install PEX piping with loop at each change of direction of more than 90 degrees.

S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

T. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in CSI Division 22 Section 220519 "Meters and Gages for Plumbing Piping."

U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in CSI Division 22 Section 220519 "Meters and Gages for Plumbing Piping."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in CSI Division 22 Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in CSI Division 22 Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in CSI Division 22 Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION:

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Joints for PEX Piping: Join according to ASTM F 1807.

3.4 HANGER AND SUPPORT INSTALLATION:

A. Comply with requirements for seismic-restraint devices in CSI Division 22 Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in CSI Division 22 Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS:

A. Plans indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code. Comply with requirements for connection sizes in CSI Division 22 plumbing fixture Sections.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection.

3.6 IDENTIFICATION:

A. Identify system components. Comply with requirements for identification materials and installation in CSI Division Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.7 FIELD QUALITY CONTROL:

A. Perform the following tests and inspections in accordance with Form 818 Article 1.20-1.05.10:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least three days before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in

segments, submit a separate report for each test, complete with diagram of portion of piping tested.

c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 ADJUSTING:

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
   b. Adjust calibrated balancing valves to flows indicated.

4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.9 CLEANING:

A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:

      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Repeat procedures if bacteriological or physical examination shows contamination.
   e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.10 PIPING SCHEDULE:

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water, building-service piping included in the MLSI, NPS 2 and smaller, shall be the following:

   1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

D. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:

   1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.

E. Domestic water piping between trap primer valves and floor drains, NPS 1/2, shall be the following:

1. PEX tube, NPS 1 and smaller; fittings for PEX tube; and crimped joints.

3.11 VALVE SCHEDULE:

A. Plans indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller.
2. Throttling Duty: Use ball valves for piping NPS 2 and smaller.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Strainers.
6. Hose bibbs.
7. Drain valves.
8. Water-hammer arresters.
9. Trap-seal primer valves.
10. Water filters.

B. Related CSI Requirements:

1. Division 22 Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Division 22 Section 221116 "Domestic Water Piping" for water meters.
3. Division 22 Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For domestic water piping specialties to include in the operation, and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Water Filter Cartridges: Equal to 200% of amount installed for each type and size indicated.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES:

A. Potable-water piping and components shall comply with NSF 61 and NSF 14.

2.2 PERFORMANCE REQUIREMENTS:

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS:

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.
b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.

5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Conbraco Industries, Inc.
   b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

2.4 BACKFLOW PREVENTERS:

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Conbraco Industries, Inc.
   b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: Full size of connecting piping.
6. Body: Bronze for NPS 2 and smaller.
7. End Connections: Threaded for NPS 2 and smaller.
8. Configuration: Designed for horizontal, straight-through flow.
9. Accessories:

   a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
   b. Air-Gap Fitting: Pressure differential relief valve with ASME A112.1.2 air-gap fitting located between two positive seating check valves, matching backflow-preventer connection.

2.5 WATER PRESSURE-REDUCING VALVES:

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Conbraco Industries, Inc.
   b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: Full size of connecting piping.
5. Type: Single-seated, direct operated.
6. Body: Bronze for NPS 2 and smaller.
7. Valves for Booster Heater Water Supply: Include integral bypass.
8. End Connections: Threaded for NPS 2 and smaller.
9. Strainer: Include integral factory-installed or separate field-installed, Y-pattern strainer.

2.6 BALANCING VALVES:

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ITT Corporation; Bell & Gossett Div.
   b. TACO Incorporated.
   c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Type: Ball valve with two readout ports and memory-setting indicator.
3. Body: Bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves:

1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.

3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

2.7 STRAINERS FOR DOMESTIC WATER PIPING:

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Size: Full size of connecting piping.
3. Body: Bronze for NPS 2 and smaller.
4. End Connections: Threaded for NPS 2 and smaller.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Perforation Size:

   a. Strainers NPS 2 and Smaller: 0.020 inch.

7. Drain: Pipe plug or factory-installed, hose-end drain valve.

2.8 HOSE BIBBS:

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze, or chrome or nickel plated.
10. Operation: Metal wheel handle.
11. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.9 DRAIN VALVES:

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.

2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 WATER-HAMMER ARRESTERS:

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Josam Company.
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   c. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows with pressurized metal cushioning chamber.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.11 TRAP-SEAL PRIMER DEVICE:

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. MIFAB, Inc.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.

5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.12 WATER FILTERS:

A. Basis-of-Design Product: Subject to compliance with requirements, provide the model numbers listed below as manufactured by CUNO Incorporated, or approved equal.

B. General: Cartridge-type assemblies suitable for potable water. Include housing, fittings, filter cartridges, and cartridge end caps.

C. Wall-Mounting Type: Housing head section with threaded inlet and outlet, mounting bracket, and removable lower section for 10-inch long filter cartridge.

1. Housing Material: Plastic, 125-psig minimum operating pressure, Model No. AP11T.
2. Cartridge: Pure white cellulose fiber filter media, 10-inches, 5-micron-particulate removable rating, Model No. AP110.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Refer to CSI Division 22 Section 221116 “Domestic Water Piping” for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system as shown on the Plans.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, and pump.

F. Install water-hammer arresters in water piping according to PDI-WH 201 and as indicated.

G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS:

A. Comply with requirements for piping specified in other CSI Division 22 Sections. Plans indicate general arrangement of piping, fittings, and specialties.

3.3 LABELING AND IDENTIFYING:

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Reduced-pressure-principle backflow preventers.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in CSI Division 22 Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL:

A. Inspect domestic water piping specialties in accordance with Form 818 Article 1.20-1.05.10.

B. Perform the following tests and inspections:

1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

C. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING:

A. Set field-adjustable pressure set points of water pressure-reducing valves.

1. Set outlet pressure to 80-psig maximum unless otherwise indicated.

B. Set field-adjustable flow set points of balancing valves.

END OF SECTION 221119

SECTION 221123 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. In-line, sealless centrifugal pumps.

B. Related CSI Sections include the following:

1. Division 23 Section 232123 "Hydronic Pumps."

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include standard wiring diagrams, materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For domestic water pumps to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE:

A. Source Limitations: Obtain hydronic pumps and domestic water pumps through one source from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Refer to Form 818 Article 1.06.03 and Form 818 Article 1.20-1.06.03 for additional information.

B. Retain shipping flange protective covers and protective coatings during storage.

C. Protect bearings and couplings against damage.

D. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 IN-LINE, SEALLESS CENTRIFUGAL PUMPS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. TACO Incorporated. Model No. 009-SF5

B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.

C. Pump Construction:

1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
2. Casing: Stainless steel, with companion-flange connections.
3. Impeller: Corrosion resistant material.
4. Motor: Single speed, unless otherwise indicated.

D. Capacities and Characteristics:

1. Capacity: 2 gpm.
2. Total Dynamic Head: 35 feet.
3. Minimum Working Pressure: 125 psig.
4. Maximum Continuous Operating Temperature: 220 deg F.
5. Inlet and Outlet Size: 1-inch.
6. Pump Speed: 3250 rpm.
7. Motor Horsepower: 1/8.
8. Electrical Characteristics:

a. Volts: 115.
b. Phases: Single.
c. Hertz: 60.

2.2 BUILDING AUTOMATION SYSTEM INTERFACE:

A. Provide auxiliary contacts in pump controllers for interface to building automation system.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION:

A. Comply with HI 1.4.

B. Install in-line, sealless centrifugal pumps with shaft horizontal unless otherwise indicated.

C. Unless otherwise required by manufacturer's written instructions, install continuous-thread hanger rods and spring hangers or spring hangers with vertical-limit stop of size required to support pump weight.

1. Comply with requirements for vibration isolation devices specified in CSI Division 22 Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in CSI Division 22 Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
3. Install seismic bracing as required by authorities having jurisdiction.

3.3 CONNECTIONS:

A. Comply with requirements for piping specified in CSI Division 22 Section 221116 "Domestic Water Piping" and CSI Division 30 Section 300700, "Drainage and Utility." Plans indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in CSI Division 22 Section 220523 "General-Duty Valves for Plumbing Piping" and comply with

requirements for strainers specified in CSI Division 22 Section 221119 "Domestic Water Piping Specialties."

2. Install pressure gage and snubber at suction of each pump and pressure gage and snubber at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in CSI Division 22 Section 220519 "Meters and Gages for Plumbing Piping."

D. Current switches for pump control, control wiring, and connections for the BAS/ATC System are specified in CSI Division 23 Section 230900, “Instrumentation and Control for HVAC.” The BAS/ATC Installer shall perform this work.

E. Comply with CSI Division 26 Sections for electrical connections, and wiring methods.

3.4 IDENTIFICATION:

A. Comply with requirements for identification specified in CSI Division 22 Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE:

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:

   a. Verify bearing lubrication.
   b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
   c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.

3.6 ADJUSTING:

A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.

3.7 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain pumps.

END OF SECTION 221123

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Pipe, tube, and fittings inside the building to a point 5-feet off the outside of the foundation wall.

1.2 PERFORMANCE REQUIREMENTS:

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Field quality-control reports.

1.5 QUALITY ASSURANCE:

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

A. Comply with requirements in Part 3.9 "Piping Schedule" for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 PVC PIPE AND FITTINGS:

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXCAVATION:

A. Refer to Form 818 Section 2.05, “Trench Excavation” for excavating, trenching, and backfilling requirements.

3.2 PIPING INSTALLATION:

A. Extend sanitary waste piping to a point 5-feet outside of the foundation wall for connection to exterior sanitary waste piping in sizes and locations indicated. Refer to CSI Division 30 Section 300700 "Drainage and Utility” for exterior sanitary waste piping.

B. Plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved by the Designer.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping tight to slabs, beams, joists, columns, walls, and other building elements.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in CSI Division 22 Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

N. Install aboveground PVC piping according to ASTM D 2665.

O. Install underground PVC piping according to ASTM D 2321.

P. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in CSI Division 22 Section 221319 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in CSI Division 22 Section 221319 "Sanitary Waste Piping Specialties."

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in CSI Division 22 Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in CSI Division 22 Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in CSI Division 22 Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION:

A. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 HANGER AND SUPPORT INSTALLATION:

A. Comply with requirements for seismic-restraint devices specified in CSI Division 22 Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in CSI Division 22 Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

G. Install supports for vertical PVC piping every 48 inches.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS:

A. Plans indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Comply with requirements for cleanouts and drains specified in CSI Division 22 Section 221319 "Sanitary Waste Piping Specialties."

5. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.6 IDENTIFICATION:

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in CSI Division 22 Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL:

A. Inspect sanitary waste and vent piping in accordance with Form 818 Article 1.20-1.05.10 and as follows:

B. During installation, notify authorities having jurisdiction at least 3 days before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

C. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

E. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.

From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING AND PROTECTION:

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.9 PIPING SCHEDULE:

A. Aboveground, soil, waste, and vent piping shall be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

B. Underground, soil, waste, and vent piping included in the MLSI shall be the following:

1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Cleanouts.
2. Floor drains.
3. Channel drainage systems.
4. Miscellaneous sanitary drainage piping specialties.

B. Related CSI Requirements:

1. Division 22 Section 221423 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Field quality-control reports.

1.4 QUALITY ASSURANCE:

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.5 COORDINATION:

A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS:

A. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Josam Company.
2) Smith, Jay R. Mfg. Co.
3) Zurn Plumbing Products Group.

2. Standard: ASME A112.36.2M for heavy-duty or threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Heavy-duty or threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Threaded.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Plastic with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification:

a. Bay Areas: Heavy Duty.
b. Office Areas: Light Duty.

13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Josam Company; Josam Div.
b. Smith, Jay R. Mfg. Co.
c. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.

4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Square, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS:

A. Cast-Iron Floor Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Series 30000-A as manufactured by Josam Company, Josam Div., or an approved equal.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Clamping Device: Not required.
7. Outlet: Bottom, inside caulk.
8. Backwater Valve: Not required.
9. Coating on Interior and Exposed Exterior Surfaces: Manufacturer's standard.
10. Sediment Bucket: Required.
11. Top or Strainer Material: Nickel bronze.
12. Top of Body and Strainer Finish: Nickel bronze.
13. Top Shape: Round.
14. Dimensions of Top or Strainer: 7 inches.
15. Top Loading Classification: Light Duty.
16. Funnel: Not required.
17. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
18. Trap Pattern: Standard P-trap.
19. Trap Features: Trap-seal primer valve drain connection.

2.3 CHANNEL DRAINAGE SYSTEMS:

A. Polymer-Concrete Channel Drainage Systems:

1. Sloped-Invert, Polymer-Concrete Channel Drainage Systems:

a. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. S300K as manufactured by ACO Polymer Products, Inc., or an approved equal.

2. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.

a. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps. Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.

   1) Dimensions: 12-inches inside width. Include number of units required to form total lengths indicated.

b. Polymer-Concrete Catch Basin: Manufacturer’s standard polymer-concrete catch basin with plastic trash bucket for collecting debris.

c. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channel sections and catch basin sections.

   1) Material: Ductile iron.
   2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

d. Covers: Solid ductile iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
e. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
f. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES:

A. Floor-Drain, Trap-Seal Primer Fittings:

   1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
   2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

B. Air-Gap Fittings:

   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Refer to CSI Division 22 Section 221316, "Sanitary Waste and Vent Piping" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates of drains flush with finished floor, unless otherwise indicated.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Assemble polymer-concrete channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

I. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS:

A. Comply with requirements in CSI Division 22 Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Plans indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FIELD QUALITY CONTROL:

A. Inspect sanitary waste piping specialties in accordance with Form 818 Article 1.20-1.05.10.

3.4 PROTECTION:

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221325 - OIL-WATER SEPARATOR

PART 1 - GENERAL

1.1 SUMMARY:

A. The Contractor shall install the complete oil-water separator system, except as otherwise noted, in conformity with the lines, grades, dimensions and details shown on the Plans and as described herein.

B. The manhole arrangement described herein and shown on the plans is based upon the oil-water separator identified herein. "Or Equal" submissions will address the need for an alternative manhole arrangement, if necessary, that is acceptable to the Designer. Alternative manhole arrangements will also be at no additional cost to the Engineer.

C. Related CSI Sections include the following:

1. Division 13 Section 132180, "Tank Monitoring System" for underground storage tank monitoring system.

1.2 DEFINITIONS:

A. FRP: Glass-fiber-reinforced plastic.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Also include, where applicable, rated capacities, operating characteristics, and furnished specialties and accessories.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: Indicate all critical dimensions, locations of all fittings, accessories, manholes, etc.

D. Quality Assurance Submittals:

1. Installer Certificates.
2. Field quality control test reports.

E. Maintenance Data: For oil-water separators to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

F. Warranty: Special warranties specified in Part 1.6, "WARRANTY."

1.4 QUALITY ASSURANCE:

A. The Oil-Water Separator Installer shall be a certified installer for the manufacturer of the oil-water separator to be installed.

B. UL Listing: The Oil-Water Separator shall comply with the construction requirements of UL 1316 and the performance testing requirements of UL 2215.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Lift oil-water separators by lifting lugs and with the proper equipment. Do not use chain or cables around oil-water separators at any time. Chock and tie-down oil-water separators in accordance with manufacturer's instructions until ready for installation. If oil-water separators have to be moved, set on smooth ground free of rocks and foreign objects, and rechock. Do not drop or roll oil-water separators. Do not allow oil-water separators to be impacted.

B. Store other material in a clean dry area protected from damage. Materials may be stored outside only with the written approval of the Engineer.

1.6 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace oil-water separators that fail in materials or workmanship within specified warranty period.

1. Oil-Water Separators:

a. Failures include, but are not limited to, the following when used for storage of fuel oil at temperatures not exceeding 150 deg F:

1) Structural failures including cracking, breakup, and collapse.
2) Corrosion failure including external and internal corrosion of tanks.

b. Warranty Period: 30 years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS:

A. Steel Pipe: Schedule 40, galvanized, conforming to ASTM A53 with zinc-coated malleable iron fittings conforming to ANSI B16.3.

B. PVC Pipe: Schedule 40, conforming to ASTM D1785 with flush, threaded joints.

C. Drainage Piping and Fittings: As specified in CSI Division 30 Section 307000, "Drainage."

2.2 PIPING SPECIALTIES:

A. Flexible Connectors: Comply with UL 567.

1. Metallic Connectors:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Flexicraft Industries.
2) FLEX-ING, Inc.; Model Fireflex with 346 swivel.
3) Hose Master, Inc.

b. Listed and labeled for aboveground and underground applications by an NRTL acceptable to authorities having jurisdiction.
c. Stainless-steel bellows with woven, flexible, bronze or stainless-steel, wire-reinforcing protective jacket.
d. Minimum Operating Pressure: 150 psig.
e. End Connections: Socket, flanged, or threaded end to match connected piping.
f. Maximum Length: 30 inches.
g. Swivel end, 50-psig maximum operating pressure.

2.3 JOINING MATERIALS:

A. Per manufacturer requirements unless otherwise noted.

2.4 FRP OIL-WATER SEPARATOR:

A. Basis-of-Design Product: Subject to compliance with requirements, double-wall, brine-filled FRP underground oil-water separators Model No. DWT (4')-1000 OWS ULCSI-10 as manufactured by Containment Solutions, Inc., or an approved equal:

B. The oil-water separators shall be designed and constructed in accordance with Stokes Law and shall meet the following:

1. Designed for gravity separation of free-floating oils from rainwater runoff or from secondary wash-down. The oil-water separators shall remove settable solids.

   a. Specific Gravity Range for Separation of Oil: 0.68-0.90.
   b. Maximum Continuous Inlet Concentration: 400 ppm.
   c. Maximum Continuous Flowrate: 100 gpm.
   d. Maximum Effluent Concentration: 10 ppm.
   e. Oil Spill Capacity: 800 gallons.

2. Have stationary under and overflow baffles to force all oil-water mixtures through the coalescing plates. There shall be two (2) sand/sludge walls separated by polypropylene coalescing plated to create a cross-flow pattern to trap settable solids.
3. The effluent downcomer shall be positioned to prevent the discharge of free oil that has been separated from the carrier liquid.
4. Separator plates shall be removable for maintenance and inspection.

C. The oil-water separators shall be inspected and tested for leakage by the manufacturer prior to shipment from the factory. The oil-water separators shall be shipped as completely assembled vessel ready for installation. Inspection, installation, and testing procedures shall be recorded on the manufacturer's letterhead and submitted to the Engineer upon delivery.

D. The oil-water separator shall be fabricated with fiberglass-reinforced polyester resins; suitable for operation at atmospheric pressure; fabricated for the following loads:

1. External Hydrostatic Pressure: To withstand general buckling with safety factor of 5:1 if hole is fully flooded and 7-feet of overburden.
2. Surface Loads: AASHTO's "Specifications for Highway Bridges," H-20 axle loads of 32,000 lb.
3. Internal Loads on Primary and Secondary Tanks: Withstand 5-psi air pressure test with a 5:1 safety factor and an operating range of 1.5-psig pressure and 3-ounces of vacuum with backfill in place. Test prior to installation to test for leakage.

2.5 OIL-WATER SEPARATOR ACCESSORIES:

A. Tank Manholes: 22-inch by 29-inch minimum (oval); bolted, flanged, and gasketed, with extension collar; for access to inside of tank.

B. Threaded pipe connection fittings on top of tank for fill, supply, return, vent, sounding, and gaging, in locations and of sizes indicated. Include cast-iron plugs for shipping.

C. Striker Plates: Inside tank, on bottom below fill, vent, sounding, gage, and other tube openings.

D. Lifting Lugs: For handling and installation.

E. Secondary Containment Collars: 42-inch diameter fiberglass collar integrally attached to the tank top to provide watertight seal in locations as indicated.

F. Containment Sumps (Turbine Enclosure): 42-inch diameter fiberglass, with sump base, add-on extension pieces as required to provide access to the manway from grade, 40-inch sump top, lid, and gasket-seal joints. Include sump entry boots for pipe penetrations through sidewalls.

G. Sump Entry Boots: Two-part pipe fitting for field assembly and of size required to fit over pipe. Include gaskets shaped to fit sump sidewall, sleeves, seals, and clamps as required for liquid-tight pipe penetrations.

H. Deadman Anchor: Storage tank manufacturer's standard pre-fabricated deadman anchor, sized and reinforced for specific tank installation.

I. Anchor Straps: Storage tank manufacturer's standard anchoring system, with straps, strap-insulating material, cables and turnbuckles, of strength at least one and one-half times maximum uplift force of empty tank without backfill in place. Furnish anchors to be attached to deadman anchors.

J. Tank Charts: Provide (3) copies. Mount 1 copy in a glass frame secured to the wall with 4 screws adjacent to the Tank Monitoring System, or as directed by the Engineer. Charts shall be calibrated to show tank capacity in gallons from feet and inches, graduated by eighths.

K. Gauge Stick: Wooden, manufacturer's recommended length, treated after graduating to prevent swelling and damage from fuel. Gauge stick shall be graduated in feet, inches, and eighths.

2.6 OIL-WATER SEPARATOR INSTALLATION MATERIALS:

A. Filter Mat: Geotextile woven or spun filter fabric, in 1 or more layers, for minimum total weight of 3 oz./sq. yd. Filter fabric shall be provided to prevent the migration of peastone gravel backfill into the native soil and to maintain the integrity and stability of the backfill materials, Model No. Typar 3401 as manufactured by Reemay, Inc., or an approved equal.

B. Peastone Gravel Backfill: Composed entirely of uncrushed stone-sized rounded particles conforming to Section M.01.01 of the Form 818, Grading No. 6, unless otherwise specified by the tank manufacturer for compliance with the tank warranty.

2.7 OIL-WATER SEPARATOR PIPING SPECIALTIES:

A. Tank Manway Assembly and Manhole for Inlet, Pump-Out, and In-Tank Probe Assemblies:

1. Manhole Frame and Cover: Composite frame with water-tight, fiberglass reinforced composite cover 36-inch diameter, Model No. FL90 as manufactured by Fiberlite, or an approved equal. Manhole frame and cover shall be black. Include one (1) lifting tool.

B. Tank Pump-Out Assembly:

1. Cap, Adapter, Suction Tube, and Slotted Pipe: 2-inch, per manufacturer's recommendations.

C. Vent Assembly:

1. Vent Cap: Open atmospheric type, corrosion-resistant, internal wire screen, designed to protect vent lines from water, debris, and insects, Model No. 23 as manufactured by OPW, or an approved equal.

D. Tank Monitoring Assemblies:

1. Probe Cap and Adaptor: Bronze, side-sealing adaptor, side sealing cap (tapped), wire grommet to secure cables, Model No. 62M as manufactured by OPW, or an approved equal.

E. Sniff Tube Assemblies:

1. Sniff Tubes: 4-inch inside diameter, Schedule 40 PVC, with flush threaded joints, Model No. 61SPVC as manufactured by OPW, or an approved equal. Sniff tubes shall be slotted 0.020-inch on center to within 2-feet of finished grade. Remaining pipe shall be solid. Wrap perforated portion of pipe with filter fabric as manufactured by Dupont Typar, or an approved equal.
2. Sniff tubes shall terminate in handholes, with Well Cap Kit Model No. 634TTM as manufactured by OPW, or an approved equal.
3. Sniff Tube Handholes: Watertight, cast iron cover with stainless steel bolts, steel skirt, 8-inch diameter, Model No. 104AOW as manufactured by OPW, or an approved equal.

F. Inlet and Outlet Assemblies:

1. Female coupling with Screw Plug: Per manufacturer's recommendations.
2. Manhole Frames and Covers (Outlet): Composite frame with water-tight, fiberglass reinforced composite cover 18-inch diameter, with manufacturer's standard locking system, and rated for H-20 loading requirements, Model No.

FL180 as manufactured by Fibrelite, or an approved equal. Include the following accessories: a 6-inch diameter identification plate labeled “OUTLET”.

2.8 LABELING AND IDENTIFYING:

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

2.9 SOURCE QUALITY CONTROL:

A. Pressure test and inspect oil-water separators, after fabrication and before shipment, according to manufacturer’s requirements and governing standards.

B. Affix standards organization's code stamp.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL:

A. Refer to 818 Section 2.02, “Roadway Excavation, Formation of Embankment and Disposal of Surplus Material” and Section 2.05, “Trench Excavation” for excavating, trenching, and backfilling requirements.

B. Peastone Gravel Backfill: Peastone Gravel shall be clean, dry and free from ice and snow, and shall be installed in accordance with the tank manufacturer’s recommendations and as indicated on the Plans.

1. Oil-water separators: Provide a minimum of 12-inches of peastone gravel bed for the oil-water separators. At start of backfilling, care must be taken to work material completely beneath the bottom of the oil-water separators and underneath the end caps to provide adequate support. Backfill completely over the top of the oil-water separators, up to bottom of the concrete apron. Peastone gravel should be added and compacted in 12-inch lifts.
2. Piping: Piping in trenches shall have the minimum burial depth as indicated on the plans with a 6-inch bed of peastone gravel under and over the pipe, compacted to support the pipe installation.

C. No backfilling over any underground piping or electrical connections may take place until the work is inspected by the Engineer and the authorities having jurisdiction. Failure to have work inspected will result in the Contractor uncovering work to allow for inspection.

3.2 OUTDOOR PIPING INSTALLATION:

A. Install underground piping buried at least 24 inches below finished grade.

B. Install drainage pipe as specified in CSI Division 22 Section 221316, “Sanitary Waste and Vent Piping” or as indicated on the Plans.

C. Install vent pipe at a minimum slope of 2 percent (1/4 inch per foot) downward towards the oil-water separators unless otherwise noted.

D. Assemble and install entry boots for pipe penetrations through sump sidewalls for liquid-tight joints.

E. Install flexible connectors at shown on the Plans. Heat shrink-wrap flexible connectors with a minimum of 2-inches overlap on each end.

F. Install fittings for changes in direction in rigid pipe.

3.3 PIPING JOINT CONSTRUCTION:

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Fiberglass-Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 OIL-WATER SEPARATOR INSTALLATION:

A. Excavate as described in Part 3.1 and as shown on the Plans. Allow for cast-in-place, concrete-ballast base plus peastone gravel between ballast base and tank. Extend excavation around perimeter of oil-water separator.

B. Install filter mat.

C. Set tie-down eyelets for hold-down straps in concrete-ballast base and tie to reinforcing steel.

D. Place peastone gravel on top of concrete-ballast base.

E. Set oil-water separator on fill materials and install hold-down straps.

1. Prior to setting oil-water separator, soap tank and pressurize primary and secondary tanks to a minimum of 3 psig and a maximum of 5 psig. Test for 1 hour. Do not install oil-water separator until the tank successfully passes this pressure test for leaks.

F. Each component of the oil-water separator system shall be installed as shown on the plans and in accordance with manufacturer recommendations. Additional installation requirements of the storage tank system are described in subsequent portions of this Section where applicable.

G. Connect piping.

H. Backfill excavation with peastone gravel in 12-inch lifts and tamp backfill lift to consolidate.

I. Install filter mat between top of backfill material and earth fill.

J. Install FRP oil-water separators with FRP hold-down straps, manhole extensions, and manhole risers.

K. Pressure Testing of Oil-Water Separator and Piping: Refer to Part 3.6, “Field Quality Control.”

1. Underground piping shall not be backfilled until the piping has successfully passed the pressure test for leaks described in this Section.

3.5 LABELING AND IDENTIFYING:

A. Install detectable warning tape directly above drainage piping, 6 inches below subgrade under pavements and slabs. Terminate tracer wire in an accessible area, and identify as "tracer wire" for future use with plastic-laminate sign.

1. Piping: Over underground piping.
2. Oil-Water Separators: Over edges of each.

3.6 FIELD QUALITY CONTROL:

A. Perform tests and inspections:

1. Oil-Water Separators: Minimum hydrostatic or compressed-air test pressures for oil-water separators for Double-Wall Tanks. Soap tanks. Isolate drainage piping from the oil-water separators during testing. In-tank probes shall not be installed in the tanks during testing.

   a. Inner Tanks: Minimum 3 psig and maximum 5 psig.
   b. Interstitial Space: Minimum 3 psig and maximum 5 psig.
   c. Maintain the test pressure for one hour.

2. Piping: Test for leaks and defects in piping.

   a. Leave drainage and vent piping uncovered until it has been tested and approved. Expose work that was covered before it was tested.
   b. Drainage Piping: Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   c. Isolate storage tanks if test pressure in piping will cause pressure in storage tanks to exceed 10 psig.

B. Piping and equipment will be considered defective if it does not pass tests and inspections. Defective piping and equipment shall be repaired or replaced, and then retested.

C. Prepare test and inspection reports.

3.7 PIPING SCHEDULE:

A. Drainage Piping and Fittings: As specified in CSI Division 30 Section 307000, "Drainage."

B. Oil-Water Separator piping shall be the following:

1. Pipe Risers: Schedule 40 PVC pipe and fittings.
2. Vent Pipe and Fittings, Underground: Schedule 40 PVC pipe and fittings.
3. Vent Pipe and Fittings, Aboveground: Galvanized steel pipe and pipe fittings.

END OF SECTION 221325

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Pipe, tube, and fittings inside the building to a point 5-feet off the outside of the foundation wall.

1.2 PERFORMANCE REQUIREMENTS:

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

B. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Quality Assurance Submittals:

1. Field quality-control reports.

1.5 QUALITY ASSURANCE:

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS:

A. Comply with requirements in Part 3.9 "Piping Schedule" for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 PVC PIPE AND FITTINGS:

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXCAVATION:

A. Refer to Form 818 Section 2.05, “Trench Excavation” for excavating, trenching, and backfilling requirements.

3.2 PIPING INSTALLATION:

A. Extend storm drainage piping to a point 5-feet outside of the foundation wall for connection to exterior storm drainage piping in sizes and locations indicated.

B. Plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations from layout are approved by the Designer.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping tight to slabs, beams, joists, columns, walls, and other building elements.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in CSI Division 22 Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

L. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

M. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert.

N. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 4 and larger.

O. Install aboveground PVC piping according to ASTM D 2665.

P. Install underground PVC piping according to ASTM D 2321.

Q. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in CSI Division 22 Section 221423 "Storm Drainage Piping Specialties."

2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in CSI Division 22 Section 221423 "Storm Drainage Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in CSI Division 22 Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in CSI Division 22 Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

3.3 JOINT CONSTRUCTION:

A. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 HANGER AND SUPPORT INSTALLATION:

A. Comply with requirements for seismic-restraint devices specified in CSI Division 22 Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in CSI Division 22 Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.

G. Install supports for vertical PVC piping every 48 inches.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS:

A. Plans indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Comply with requirements for cleanouts and drains specified in CSI Division 22 Section 221423 "Storm Drainage Piping Specialties."

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.6 IDENTIFICATION:

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in CSI Division 22 Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL:

A. Inspect storm drainage piping in accordance with Form 818 Article 1.20-1.05.10 and as follows:

B. During installation, notify authorities having jurisdiction at least 3 days before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

C. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

E. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.8 CLEANING:

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING SCHEDULE:

A. Aboveground storm drainage piping shall be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

B. Underground storm drainage piping included in the MLSI shall be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Roof drains.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE:

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS:

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Series 21500-AE as manufactured by Josam Company; Josam Div., or an approved equal.
2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 14-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Outlet: Bottom, 6-inch minimum diameter.
7. Extension Collars: Required.
8. Underdeck Clamp: Required.
9. Sump Receiver Plate: Required.
10. Dome Material: Rough bronze.
11. Vandal-Proof Dome: Required.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in CSI Division 07 Sections.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

3.2 CONNECTIONS:

A. Comply with requirements for piping specified in CSI Division 22 Section 221413 "Facility Storm Drainage Piping." Plans indicate general arrangement of piping, fittings, and specialties.

3.3 PROTECTION:

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 221513 - GENERAL-SERVICE COMPRESSED-AIR PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes piping and related specialties for general-service compressed-air systems operating at 200 psig or less.

B. Related CSI Sections include the following:

1. Division 22 Section 221519 "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

1.2 DEFINITIONS:

A. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following:

1. Plastic pipes, fittings, and valves.
2. Flexible pipe connectors.
3. Safety valves.
4. Pressure regulators. Include rated capacities and operating characteristics.
5. Automatic drain valves.
6. Filters. Include rated capacities and operating characteristics.
7. Lubricators. Include rated capacities and operating characteristics.
8. Quick couplings.
9. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.4 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in the operation, and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE:

A. ASME Compliance:

1. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS:

A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.

1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.

B. PVC Pipe: ASTM D 1785, Schedule 40.

1. PVC Fittings: ASTM D 2466, Schedule 40, socket type.

2.2 JOINING MATERIALS:

A. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer complying with ASTM F 656.

2.3 VALVES:

A. Metal Ball, Butterfly, and Check Valves: Comply with requirements in CSI Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."

2.4 FLEXIBLE PIPE CONNECTORS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flexicraft Industries.
2. Hyspan Precision Products, Inc.
3. Metraflex, Inc.

B. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: 200 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.

2.5 SPECIALTIES:

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Line Pressure Regulators: Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

C. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate.

D. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated.

E. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type, 40 micron thick filters with edge filtration, and drain cock. Include mounting bracket if wall mounting is indicated.

F. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting is indicated.

2.6 QUICK COUPLINGS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aeroquip Corporation; Eaton Corp.
2. Parker Hannifin Corp.; Fluid Connectors Group; Quick Coupling Div.
3. Schrader-Bridgeport; Amflo Div.Schrader-Bridgeport/Standard Thomson.

C. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

D. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts. Couplings shall be 3/8" and 1/2" connection size, Industrial Interchange type.

1. Socket End: With one-way valve and threaded inlet for connection to piping.
2. Plug End: Straight-through type with barbed or threaded outlet for attaching hose.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS:

A. Compressed-Air Piping between Air Compressors and Receivers: Use the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.

B. Low-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.

C. Drain Piping: Use the following piping materials:

1. NPS 2 and Smaller: PVC pipe and fittings; and solvent-cemented joints.

3.2 VALVE APPLICATIONS:

A. General-Duty Valves: Comply with requirements in CSI Division 22 Section 220523 "General-Duty Valves for Plumbing Piping" for metal general-duty valves. Use metal valves, unless otherwise indicated.

1. Metal General-Duty Valves: Use valve types specified in Part 3 "Valve Applications" in CSI Division 22 Section 220523 "General-Duty Valves for Plumbing Piping" according to the following:

a. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
b. Equipment Isolation NPS 2 and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.

3.3 PIPING INSTALLATION:

A. Plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved by the Designer.

B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.

E. Install piping adjacent to equipment and machines to allow service and maintenance.

F. Install air and drain piping with 1 percent slope downward in direction of flow.

G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

H. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

I. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

J. Install pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in CSI Division 22 Section 220519 "Meters and Gages for Plumbing Piping."

K. Install piping to permit valve servicing.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in CSI Division 22 Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

3.4 JOINT CONSTRUCTION:

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Solvent-Cemented Joints for PVC Piping: Clean and dry joining surfaces. Join according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. Apply primer and join according to ASME B31.9 for solvent-cemented joints and to ASTM D 2672.

3.5 VALVE INSTALLATION:

A. General-Duty Valves: Comply with requirements in CSI Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."

B. Install shutoff valves and unions at compressed-air piping to air compressors.

C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator, and as shown on the Plans.

D. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.6 FLEXIBLE PIPE CONNECTOR INSTALLATION:

A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

B. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.7 SPECIALTY INSTALLATION:

A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.

B. Install air-line pressure regulators in branch piping as shown on the Plans.

C. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor drain.

D. Install coalescing filters in compressed-air piping at or near air compressors.

E. Install mechanical filters in branch piping as shown on the Plans.

F. Install air-line lubricators in branch piping as shown on the Plans.

G. Install quick couplings at piping terminals for hose connections.

3.8 CONNECTIONS:

A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

3.9 HANGER AND SUPPORT INSTALLATION:

A. Comply with requirements in CSI Division 22 Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

B. Vertical Piping: MSS Type 8 or 42, clamps.

C. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

D. Base of Vertical Piping: MSS Type 52, spring hangers.

E. Support horizontal piping within 12 inches of each fitting and coupling.

F. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

G. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 to NPS 1/2: 96 inches with 3/8-inch rod.
2. NPS 3/4 to NPS 1-1/4: 84 inches with 3/8-inch rod.
3. NPS 1-1/2: 12 feet with 3/8-inch rod.

H. Install supports for vertical, Schedule 40, steel piping every 15 feet.

3.10 LABELING AND IDENTIFICATION:

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in CSI Division 22 Section 220553 "Identification for Plumbing Piping and Equipment."

3.11 FIELD QUALITY CONTROL:

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Repair leaks and retest until no leaks exist.
3. Inspect filters, lubricators, and pressure regulators for proper operation.

C. Prepare test reports.

END OF SECTION 221513

SECTION 221519 - GENERAL-SERVICE PACKAGED AIR COMPRESSORS AND RECEIVERS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Oil-free, reciprocating air compressors.
2. Inlet-air filters.
3. Air-cooled, compressed-air aftercoolers.
4. Refrigerant compressed-air dryers.

1.2 DEFINITIONS:

A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.

B. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include diagrams for power, signal, and control wiring.
3. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Delegated-Design Submittal: For compressed-air equipment mounting.

1. Detail fabrication and assembly of supports.
2. Include design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS:

A. Seismic Qualification Certificates: For compressed-air equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Quality Assurance Submittals:

1. Startup Service Reports.

1.5 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For compressed-air equipment to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 SPARE PARTS:

A. Furnish to the Engineer spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Air-Compressor, Inlet-Air-Filter Elements: Equal to 100 percent of amount installed, but no fewer than 1 units.
2. Belts: One for each belt-driven compressor.

1.7 FIELD CONDITIONS:

A. Interruption of Existing Compressed-Air Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Engineer no fewer than 7 calendar days in advance of proposed interruption of compressed-air service.
2. Do not proceed with interruption of compressed-air service without Engineer's written permission.

1.8 COORDINATION:

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace air compressors and accessories that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 2-years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION:

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

2.2 PERFORMANCE REQUIREMENTS:

A. Delegated Design: Design compressed-air equipment mounting, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Compressed-air equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.3 GENERAL REQUIREMENTS FOR PACKAGED AIR COMPRESSORS AND RECEIVERS:

A. General Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.

B. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.

1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
2. Motor Controllers: Full-voltage, combination magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
3. Control Voltage: 120-V ac or less, using integral control power transformer.
4. Motor Overload Protection: Overload relay in each phase.
5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
6. Instrumentation: Include discharge-air pressure gage, air-filter maintenance indicator, hour meter, compressor discharge-air and coolant temperature gages, and control transformer.

C. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1. Pressure Rating: At least as high as highest discharge pressure of connected compressors, and bearing appropriate code symbols.
2. Interior Finish: Corrosion-resistant coating.
3. Accessories: Include safety valve, pressure gage, drain, and pressure-reducing valve.

D. Mounting Frame: Fabricate mounting and attachment to pressure vessel with reinforcement strong enough to resist packaged equipment movement during a seismic event when base is anchored to building structure.

2.4 OIL-FREE, RECIPROCATING AIR COMPRESSORS (REPAIR FACILITY):

A. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. 2-2475E7.5 as manufactured by Ingersoll-Rand; Air Solutions Group, or an approved equal.

B. Compressor(s): Reciprocating-piston type.

1. Cylinders: 100% cast iron, separately cast, and individually bolted to the frame in a V-type configuration.
2. Frame: 100% cast iron.

3. Intercooler: Fined copper tube construction.
4. Lubrication: Splash lubrication system with lubrication dipper integral to the connecting rod.
5. Belt guard totally enclosing pulleys and belts.

C. Capacities and Characteristics:

1. Air Compressor(s): Two; two stage.
2. Actual-Air Capacity of Each Air Compressor: 25.25 acfm delivered.
3. Discharge-Air Pressure: 125 psig.
4. Mounting: Tank mounted.
5. Motor (Each Air Compressor):

   a. Horsepower: 7.5.
   b. Speed: 1100 rpm.

6. Electrical Characteristics:

   a. Volts: 208.
   b. Phase(s): Three.
   c. Hertz: 60.

7. Receiver: ASME construction steel tank.

   a. Arrangement: Horizontal.
   b. Capacity: 120 gal.
   c. Pressure Rating: 125 psig minimum.
   d. Drain: Automatic valve.

2.5 RECIPROCATING AIR COMPRESSORS (MAINTENANCE FACILITY):

A. Basis-of-Design Product: Subject to compliance with requirements, provide Type 30 Model No. 2475N7.5 as manufactured by Ingersoll-Rand; Air Solutions Group, or an approved equal.

B. Compressor(s): Reciprocating-piston type with lubricated crankcase, and of construction that prohibits oil from entering compression chamber.

1. Lubrication: Splash lubrication system.
2. Oil filter.
3. Combined high discharge-air temperature and low lubrication-oil pressure switch.
4. Belt guard totally enclosing pulleys and belts.

C. Capacities and Characteristics:

1. Air Compressor(s): One; two stage.
2. Actual-Air Capacity of Each Air Compressor: 24.2 acfm delivered.

3. Discharge-Air Pressure: 125 psig.
4. Mounting: Tank mounted.
5. Motor (Each Air Compressor):

    a. Horsepower: 7.5.
    b. Speed: 1750 rpm.

6. Electrical Characteristics:

    a. Volts: 200.
    b. Phase(s): Three.
    c. Hertz: 60.

7. Receiver: ASME construction steel tank.

    a. Arrangement: Vertical.
    b. Capacity: 80 gal.
    c. Pressure Rating: 125 psig minimum.
    d. Drain: Automatic valve.

2.6 INLET-AIR FILTERS:

A. Description: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.

1. Construction: Durable housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
2. Capacity: Match capacity of air compressor, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.

2.7 AIR-COOLED, COMPRESSED-AIR AFTERCOOLERS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ingersoll-Rand Company; Compressed Air Solutions.
2. Van Air Systems.
3. ZEKS Compressed Air Solutions.

B. Description: Electric-motor-driven, fan-operation, finned-tube unit; rated at 250 psig and leak tested at 350-psig minimum air pressure; in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 25 deg F above summertime maximum ambient temperature. Include moisture separator and automatic drain.

C. Capacities and Characteristics:

1. Standard-Air Capacity of Each Aftercooler: 75 scfm free air.

2.8 REFRIGERANT COMPRESSED-AIR DRYERS:

A. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. 75HSG as manufactured by Zeks Air Solutions, or an approved equal.

B. Description: Cycling, air-cooled, electric-motor-driven unit with steel enclosure and capability to deliver 38 deg F, 100-psig air at dew point. Include automatic ejection of condensate from airstream, step-down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.

C. Capacities and Characteristics:

1. Standard-Air Capacity of Each Compressed-Air Dryer: 75 scfm free air.
2. Maximum Air-Pressure Drop: 5 psig.
3. Electrical Characteristics:

a. Volts: 115.
b. Phase(s): Single.
c. Hertz: 60.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION:

A. Equipment Mounting:

1. Install air compressors, aftercoolers, and air dryers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in CSI Division 03 Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

a. Minimum Deflection: As required.
b. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
c. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
d. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

e. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Install compressed-air equipment anchored to substrate.

C. Arrange equipment so controls and devices are accessible for servicing.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Install the following devices on compressed-air equipment:

1. Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
2. Pressure Regulators: Install downstream from air compressors and dryers.
3. Automatic Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate onto floor.

3.2 CONNECTIONS:

A. Comply with requirements for piping specified in CSI Division 22 Section 221513 "General-Service Compressed-Air Piping." Plans indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to machine, allow space for service and maintenance.

3.3 IDENTIFICATION:

A. Identify general-service air compressors and components. Comply with requirements for identification specified in CSI Division 22 Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check for lubricating oil in lubricated-type equipment.
3. Check belt drives for proper tension.
4. Verify that air-compressor inlet filters and piping are clear.
5. Check for equipment vibration-control supports and flexible pipe connectors, and verify that equipment is properly attached to substrate.
6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.
7. Check for proper seismic restraints.
8. Drain receiver tanks.

9. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
10. Test and adjust controls and safeties.

B. Prepare written report documenting testing procedures and results.

3.5 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors, aftercoolers, and air dryers.

END OF SECTION 221519

SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Commercial, power-burner, gas-fired, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.2 PERFORMANCE REQUIREMENTS:

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS:

A. Seismic Qualification Certificates: For fuel-fired, domestic-water heaters, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Source quality-control reports.
3. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in the operation, and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranties: Special warranties specified in Part 1.8 “WARRANTY.”

1.6 QUALITY ASSURANCE:

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.

C. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.7 COORDINATION:

A. Coordinate sizes and locations of concrete bases. Concrete, reinforcement, and formwork requirements are specified in CSI Division 03.

1.8 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period for Storage Tank: From the issuance of the Certificate of Compliance: 10 years. The first 5 years shall be unlimited with the 6th through 10th years pro-rated.

PART 2 - PRODUCTS

2.1 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS:

A. Commercial, Power-Burner, Gas-Fired, Storage, Domestic-Water Heaters:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. 27 L 125A-MXS as manufactured by PVI Industries, LLC., or an approved equal.
2. Standard: ANSI Z21.10.3/CSA 4.3.
3. Storage-Tank Construction: ASME-code steel with 150-psig working-pressure rating.

a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.

b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

4. Factory-Installed Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.

d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
e. Jacket: Steel with enameled finish.
f. Burner: UL 795 for power-burner, gas-fired, domestic-water heaters and natural-gas fuel.
g. Automatic Ignition: ANSI Z21.20/CSA C22.2 No. 199, electric, automatic, gas-ignition system.
h. Temperature Control: Adjustable thermostat.
i. Interlock: The burner operation circuit shall be electronically interlocked through end switches located on the combustion air dampers which will ensure that the combustion air dampers are open before the burner can operate. The combustion air dampers shall close in the event of a flame failure.
j. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

5. Draft Hood: Draft diverter, complying with ANSI Z21.12.

B. Capacity and Characteristics:

1. Capacity: 125 gal.
2. Recovery: 270 gph at 100 deg F temperature rise.
3. Temperature Setting: 140 deg F.
4. Fuel Gas Input: 270,000 Btu/h.
5. Gas Pressure Regulator:

a. Inlet Pressure: 14 inches water column maximum.
b. Gas Pressure Required at Burner: 4.5 inches water column minimum.

6. Electrical Characteristics:

a. Volts: 120.
b. Phase: Single.
c. Hertz: 60.

7. Minimum Vent Diameter: 6 inches.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AMTROL Inc.
b. Taco, Inc.

2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:

a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
c. Air-Charging Valve: Factory installed.

4. Capacity and Characteristics:

a. Working-Pressure Rating: 150 psig.
b. Capacity Acceptable: 3.2 gal. minimum.
c. Air Precharge Pressure: 40 psig.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

C. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.

D. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include pressure rating, capacity, and pressure differential as required to match gas supply.

E. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.

F. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

G. Emergency Shutoff Switch: Furnish to the Electrical Installer for installation where shown on the Plans.

2.3 SOURCE QUALITY CONTROL:

A. Factory Tests: Test and inspect assembled domestic-water heaters and storage tanks specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION:

A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on 6-inch thick concrete base, 4-inches larger on each side than the base of the water heater. Concrete bases shall be installed by the Concrete Installer in the locations indicated by the Mechanical Installer. Comply with requirements for concrete base specified in CSI Division 03 Section 033000 "Cast-in-Place Concrete."

1. Anchor domestic-water heaters to substrate.

B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in CSI Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."

C. Install gas-fired, domestic-water heaters according to NFPA 54.

1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.

4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in CSI Division 23 Section 231123 "Facility Natural-Gas Piping."

D. Install commercial domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in CSI Division 22 Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

E. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in CSI Division 22 Section 221119 "Domestic Water Piping Specialties."

G. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in CSI Division 22 Section 220519 "Meters and Gages for Plumbing Piping."

H. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill domestic-water heaters with water.

J. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS:

A. Comply with requirements for domestic-water piping specified in CSI Division 22 Section 221116 "Domestic Water Piping."

B. Comply with requirements for gas piping specified in CSI Division 23 Section 231123 "Facility Natural-Gas Piping."

C. Plans indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION:

A. Identify system components. Comply with requirements for identification specified in CSI Division 22 Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL:

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, domestic-water heaters.

END OF SECTION 223400

SECTION 224213 - COMMERCIAL WATER CLOSETS AND URINALS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Water closets.
2. Urinals.
3. Flushometer valves.
4. Toilet seats.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets and urinals.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 SPARE PARTS:

A. Furnish to the Engineer spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: At least one (1) set of each type and size installed.
2. Hybrid Urinal Cartridges and Repair Kits: At least one (1) set of each type and size installed.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS:

A. Water Closets: Floor mounted, bottom outlet, top spud.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the models listed below as manufactured by Kohler Co., or approved equals.

a. Standard Water Closet: Model No. K-4406, "Wellworth."
b. Accessible Water Closet: Model No. K-4405, "Highline."

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.
d. Style: Flushometer valve.
e. Height: Standard or accessible as specified.
f. Rim Contour: Elongated.
g. Water Consumption: 1.28 gal. per flush.
h. Spud Size and Location: NPS 1-1/2; top.
i. Color: White.

3. Flushometer Valve: As specified.
4. Toilet Seat: As specified.

2.2 WALL-HUNG URINALS:

A. Urinals: Wall hung, back outlet, hybrid, accessible.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. HYB-1000 as manufactured by Sloan, or an approved equal.
2. Fixture:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Trap-Seal Method: Proprietary cartridge with liquid seal.
d. Supply: 3/8-inch compression
e. Outlet Size and Location: NPS 2, back.
f. Color: White.
g. Automatic Rinse Operation: Injects 1 gallon of water through housing and drain line every 72 hours to prevent struvite build-up and clogs. Include IR switch for manual rinse activation.

3. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
b. Size: NPS 2.

4. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

2.3 WATER CLOSET FLUSHOMETER VALVES:

A. Solenoid-Actuator, Diaphragm Flushometer Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. Sloan ESS-111-1.28-DFB-OR-HW as manufactured by Sloan Valve Co., or an approved equal.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Style: Exposed.
8. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
9. Trip Mechanism: Hard-wired electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
10. Consumption: 1.28 gal. per flush.
11. Minimum Inlet: NPS 1.
12. Minimum Outlet: NPS 1-1/4.

2.4 TOILET SEATS:

A. Toilet Seats:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. K-4731-C-7 as manufactured by Kohler Co., or an approved equal.
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Check.
7. Hinge Material: Noncorroding metal.
8. Color: Black.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet and urinal installation.

B. Examine walls and floors for suitable conditions where water closets and urinals will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.

B. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

C. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use carriers without waste fitting for urinals with tubular waste piping.
4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

D. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install actuators in locations that are easy for people with disabilities to reach.

E. Install toilet seats on water closets.

F. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in CSI Division 22 Section 220518 "Escutcheons for Plumbing Piping."

G. Joint Sealing:

1. Seal joints between water closets and floors and urinals and walls using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet and urinal color.
3. Comply with sealant requirements specified in CSI Division 07 Section 079200 "Joint Sealants."

3.3 CONNECTIONS:

A. Connect water closets and urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets and urinals.

B. Comply with water piping requirements specified in CSI Division 22 Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in CSI Division 22 Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets and urinals, allow space for service and maintenance.

3.4 ADJUSTING:

A. Operate and adjust water closets, urinals and controls. Replace damaged and malfunctioning water closets, urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION:

A. Clean water closet, urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets, urinals and fittings.

C. Do not allow use of water closets and urinals for temporary facilities unless approved in writing by the Engineer.

END OF SECTION 224213

SECTION 224216 - COMMERCIAL LAVATORIES AND SINKS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Lavatories.
2. Service basins.
3. Kitchen sinks.
4. Faucets.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories and sinks.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For lavatories, sinks, and faucets to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 SPARE PARTS:

A. Furnish to the Engineer spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: At least one (1) set of each type and size installed.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES:

A. Lavatory: Vitreous china, wall mounted, with back.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. K-2031, “Greenwich” as manufactured by Kohler Co., or an approved equal.
2. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.
b. Type: For wall hanging.
c. Nominal Size: 20-3/4 by 18-1/4-inches rectangular.
d. Faucet-Hole Punching: One hole.
e. Faucet-Hole Location: Top.
f. Color: White.
g. Mounting Material: Chair carrier.

3. Faucet: As specified.
4. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier. Include rectangular, steel uprights.
5. Supply Fittings: Chrome-plate copper with stops.
6. Waste Fittings: Chrome-plated cast brass P-trap; 0.045-inch thick tubular brass waste to wall, and wall escutcheons.
7. Protective Shielding Guards: As specified.

2.2 SERVICE BASINS:

A. Service Basins: Molded stone, floor mounted.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. MSB-3624 as manufactured by Crane Plumbing, L.L.C./Fiat Products, or an approved equal.
2. Fixture:

a. Standard: IAPMO PS 99.
b. Shape: Rectangular.
c. Nominal Size: 24 by 36 inches.
d. Height: 10 inches.
e. Tiling Flange: Not required.
f. Rim Guard: On all top surfaces.
g. Color: White.
h. Drain: Grid with NPS 2 outlet.

3. Mounting: On floor and flush to wall.

4. Faucet: As specified.

2.3 KITCHEN SINKS:

A. Kitchen Sinks: One bowl, counter mounted, stainless steel.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. SL-ADA-1921-A-GR, as manufactured by Just Manufacturing Co., or an approved equal.
2. Fixture:

a. Standard: ASME A112.19.3/CSA B45.4 for stainless-steel kitchen sinks.
b. Overall Dimensions: 19 by 21 inches.
c. Metal Thickness: 18 gauge.
d. Bowl:

1) Dimensions: 14 by 18 inches.
2) Drain: 3-1/2-inch stainless steel crumb cup, Model No. J-ADA-35, as manufactured by Just Manufacturing Co., or approved equal.

a) Location: Centered in bowl.

3. Faucet: As specified.
4. Supply Fittings: Chrome-plated copper with stops.
5. Waste Fittings: Chrome-plated cast brass P-trap; 0.045-inch thick tubular brass waste to wall, and wall escutcheons.
6. Protective Shielding Guards: As specified.

2.4 AUTOMATICALLY OPERATED LAVATORY FAUCETS:

A. NSF Standard: Comply with NSF 61 and NSF 372 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets - Automatic Type: Hardwired Electronic Sensor Operated, Mixing:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. K-13462 as manufactured by Kohler Co., or an approved equal.
2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
5. Body Type: Single hole.

6. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 0.5 gpm.
9. Mounting Type: Deck, concealed.
10. Spout: Rigid type.
11. Spout Outlet: Aerator.
12. Drain: Grid.

2.5 SOLID-BRASS, MANUALLY OPERATED FAUCETS:

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Service Basin Faucets: Manual type, two-lever-handle mixing valve.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. 830-AA as manufactured by Crane Plumbing, L.L.C./Fiat Products, or approved equal.
2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Material: Cast brass.
5. Finish: Rough chrome plate.
6. Maximum Flow Rate: 2.2 gpm.
7. Handle(s): Knob.
8. Mounting Type: Back/wall, exposed.
9. Spout Type: Rigid, cast brass with wall brace.
10. Vacuum Breaker: Required for hose outlet.
11. Spout Outlet: Hose thread according to ASME B1.20.7.

C. Sink Faucets: Solid brass, kitchen sink.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. K-15172-TL “Coralais” as manufactured by Kohler Co., or an approved equal.
2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
4. Kitchen Sink Option: Separate hand spray complying with ASSE 1025.
5. Finish: Polished chrome plate.
6. Maximum Flow Rate: 1.8 gpm.
7. Mixing Valve: Single control.
8. Backflow-Prevention Device for Hand Spray: Not required.
9. Centers: 4 inches and 8 inches to the right of center.

10. Mounting: Deck, exposed.
11. Handle(s): Loop, 6-3/8-inches long.
12. Spout Type: Swing, shaped tube, 8-1/2-inches long.
13. Spout Outlet: Aerator.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory and sink installation.

B. Examine counters and walls for suitable conditions where lavatories and sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Install lavatories and sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories and wall-hung sinks.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball valves if supply stops are not specified with sink. Comply with valve requirements specified in CSI Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in CSI Division 22 Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between lavatories, sinks, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in CSI Division 07 Section 079200 "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in CSI Division 22 Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS:

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in CSI Division 22 Section 221116, "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in CSI Division 22 Section 221316, "Sanitary Waste and Vent Piping."

D. Connect wiring according to CSI Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

E. Ground equipment according to CSI Division 26 Section 260526, "Grounding and Bonding for Electrical Systems."

F. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.

G. Identify electrical equipment and connections according to CSI Division 26 Section 260553, "Identification for Electrical Systems."

3.4 ADJUSTING:

A. Operate and adjust lavatories, sinks, and controls. Replace damaged and malfunctioning lavatories, sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION:

A. After completing installation of lavatories and sinks, inspect and repair damaged finishes.

B. Clean lavatories, sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories, sinks, and fittings.

D. Do not allow use of lavatories and sinks for temporary facilities unless approved in writing by the Engineer.

END OF SECTION 224216

SECTION 224223 - COMMERCIAL SHOWERS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Individual shower receptors.
2. Shower faucets.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for showers.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
3. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For plumbing fixtures to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 SPARE PARTS:

A. Furnish to the Engineer spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: At least one (1) set of each type and size installed.

PART 2 - PRODUCTS

2.1 INDIVIDUAL SHOWERS:

A. Individual Showers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. S4136BF as manufactured by Aquarius Bathware, or an approved equal.
2. General: FRP or acrylic, accessible, shower enclosure with faucet and receptor and appurtenances.
3. Standard: ANSI Z124.1.2.
4. Type: One-piece unit with top.
5. Style: Handicapped/wheelchair.
6. Faucet: As specified.
7. Nominal Size and Shape: 36 by 36 inches square.
8. Color: White.
9. Bathing Surface: Slip resistant according to ASTM F 462.
10. Outlet: Drain with NPS 2 outlet.
11. Shower Rod and Curtain: Required.
12. Grab Bar: ASTM F 446, mounted on support area back wall.
13. Dome Light: 60-Watt, recessed round shower light.

2.2 SHOWER FAUCETS:

A. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for shower materials that will be in contact with potable water.

B. Shower Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. S-96-300-B30-L-V-1.5 as manufactured by Symmons Industries, Inc., or an approved equal.
2. Description: Single-handle, pressure-balance mixing valve with hot- and cold-water indicators; check stops; and shower head.
3. Faucet:

a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.
b. Body Material: Solid brass.
c. Finish: Polished chrome plate.
d. Maximum Flow Rate: 2.5 gpm unless otherwise indicated.
e. Mounting: Exposed.
f. Operation: Single-handle, twist or rotate control.
g. Antiscald Device: Integral with mixing valve.
h. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

4. Supply Connections: NPS 1/2.
5. Shower Head:

    a. Standard: ASME A112.18.1/CSA B125.1.
    b. Type: Ball joint with arm and flange.
    c. Shower Head Material: Metallic with chrome-plated finish.
    d. Spray Pattern: Adjustable.
    e. Integral Volume Control: Required.
    f. Shower-Arm, Flow-Control Fitting: 1.5 gpm.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before shower installation.

B. Examine walls and floors for suitable conditions where showers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Assemble shower components according to manufacturers' written instructions.

    1. Install shower faucet and accessories per ADA requirements.

B. Install showers level and plumb according to roughing-in drawings.

C. Install water-supply piping with stop on each supply to each shower faucet.

    1. Exception: Use ball valves if supply stops are not specified with shower. Comply with valve requirements specified in CSI Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."
    2. Install stops in locations where they can be easily reached for operation.

D. Install shower flow-control fittings with specified maximum flow rates in shower arms.

E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheons requirements specified in CSI Division 22 Section 220518 "Escutcheons for Plumbing Piping."

F. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in CSI Division 07 Section 079200 "Joint Sealants."

3.3 CONNECTIONS:

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in CSI Division 22 Section 221116 "Domestic Water Piping."

C. Comply with traps and soil and waste piping requirements specified in CSI Division 22 Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING:

A. Operate and adjust showers and controls. Replace damaged and malfunctioning showers, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION:

A. After completing installation of showers, inspect and repair damaged finishes.

B. Clean showers, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed fixtures and fittings.

D. Do not allow use of showers for temporary facilities unless approved in writing by the Engineer.

END OF SECTION 224223

SECTION 224233 - WASH FOUNTAINS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Semicircular wash fountains.

B. Related Requirements:

1. CSI Division 22 Section 224216 "Commercial Lavatories and Sinks."

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for wash fountains.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
3. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For wash fountains and components to include in operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 SPARE PARTS:

A. Furnish to the Engineer spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: At least one (1) set of each type and size installed.

PART 2 - PRODUCTS

2.1 PRECAST-TERRAZZO, SEMICIRCULAR WASH FOUNTAINS:

A. Wash Fountains: On-floor, precast-terrazzo, semicircular receptor.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. WF2603 as manufactured by Bradley Corp., or an approved equal.
2. Standard: IAPMO IGC 156.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Receptor:

    a. Standard: IAPMO PS 99 for precast-terrazzo receptor.
    b. Nominal Diameter: 36 to 39 inches.
    c. Height to Rim: 29 inches above floor.
    d. Drain: Grid with NPS 2 tailpiece.

5. Spray Head:

    a. Material: Stainless steel or integral part of receptor back.
    b. Number of User Stations: Three.
    c. Spray Nozzles: Chrome-plated brass or stainless steel complying with NSF 61 and ASME A112.18.1/CSA B125.1.
    d. Control: Collective, foot-rail actuation with thermostatic mixing valve complying with ASSE 1016 and having check stops; comply with NSF 61.
    e. Minimum Flow Rate: 1.25 gpm.

6. Liquid-Soap Dispensers: Manual, for each user station.
7. On-Floor Mounting: Floor bracket and wall bracket attached to concrete or block wall.

    a. Supplies: NPS 1 copper tubing with ball valves.
    b. Drain: Grid with NPS 2 tailpiece.
    c. Drain Piping: NPS 2 P-trap, waste to wall, and wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine roughing-in of water-supply, sanitary drainage, and vent piping systems to verify actual locations of piping connections before wash-fountain installation.

B. Examine walls and floors for suitable conditions where wash fountains will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Install wash fountains level and plumb according to roughing-in drawings.

B. Set freestanding wash fountains on floor.

C. Install water-supply piping with shutoff valve on each supply to each wash fountain to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in CSI Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."

D. Install trap and waste piping on each drain outlet of each wash fountain to be connected to sanitary drainage system.

E. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in CSI Division 07 Section 079200 "Joint Sealants."

3.3 CONNECTIONS:

A. Connect wash fountains with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with requirements for water piping specified in CSI Division 22 Section 221116 "Domestic Water Piping."

C. Comply with requirements for soil and waste drainage piping and vent piping specified in CSI Division 22 Section 221316 "Sanitary Waste and Vent Piping."

D. Install protective-shielding pipe covers and enclosures on exposed supplies and waste piping of accessible wash fountains. Comply with requirements in CSI Division 22 Section 220719 "Plumbing Piping Insulation."

3.4 ADJUSTING:

A. Operate and adjust wash fountains and controls. Replace damaged and malfunctioning wash fountains, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION:

A. After installing wash fountains, inspect and repair damaged finishes.

B. Clean wash fountains, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed wash fountains and fittings.

D. Do not allow use of wash fountains for temporary facilities unless approved in writing by the Engineer.

END OF SECTION 224233

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Eyewash equipment.
2. Water-tempering equipment.

1.2 DEFINITIONS:

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Tepid: Moderately warm.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: Diagram power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Product Certificates: Submit certificates of performance testing specified in Part 2.3 "Source Quality Control."
2. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE:

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

D. Regulatory Requirements: Comply with requirements in ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

PART 2 - PRODUCTS

2.1 EYE/FACE WASH EQUIPMENT:

A. Accessible, Freestanding, Plumbed, Eye/Face Wash Units:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. S19214Y as manufactured by Bradley Corp., or an approved equal.
2. Capacity: Not less than 3 gpm for at least 15 minutes.
3. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
4. Control-Valve Actuator: Paddle.
5. Spray-Head Assembly: Two or four receptor-mounted spray heads.
6. Receptor: Stainless-steel bowl.
7. Drain Piping: NPS 1-1/4 minimum, galvanized-steel indirect connection to drainage system.
8. Mounting: Offset pedestal.
9. Special Construction: Comply with ICC/ANSI A117.1.

2.2 WATER-TEMPERING EQUIPMENT:

A. Hot- and Cold-Water, Water-Tempering Equipment:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. S19-2000 as manufactured by Bradley Corp., or approved equal.
2. Description: Factory-fabricated equipment with thermostatic mixing valve.

a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
b. Supply Connections: For hot and cold water.

2.3 SOURCE QUALITY CONTROL:

A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION:

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in CSI Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."

E. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in CSI Division 22 Section 220519 "Meters and Gages for Plumbing Piping."

F. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in CSI Division 22 Section 221316 "Sanitary Waste and Vent Piping."

3.3 CONNECTIONS:

A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in CSI Division 22 Section 221116 "Domestic Water Piping."

B. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment as indicated on the Plans. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in CSI Division 22 Section 221116 "Domestic Water Piping."

C. Connect cold water and electrical power to electric heating water-tempering equipment as indicated on the Plans. Comply with requirements for cold-water piping specified in CSI Division 22 Section 221116 "Domestic Water Piping."

D. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.

E. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION:

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in CSI Division 22 Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL:

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection.

2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING:

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 224500

SECTION 224716 - PRESSURE WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes pressure water coolers and related components.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of pressure water cooler.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For pressure water coolers to include in operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS:

A. Pressure Water Coolers: Wall mounted, wheelchair accessible, bottle filler.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. LZS8WSLK," as manufactured by Elkay or an approved equal.
2. Standards:

a. Comply with NSF 61 and NSF 372.
b. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.

c. Comply with ICC A117.1.

3. Cabinet: Single, vinyl-covered steel with stainless-steel top.
4. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
5. Control: Push bar.
6. Bottle Filler: Sensor activation with 20-second automatic shutoff timer. Fill rate 1.1 gpm.
7. Drain: Grid with NPS 1-1/4 tailpiece.
8. Supply: NPS 3/8 with shutoff valve.
9. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
10. Filter: As specified in CSI Division 22 Section 221119, "Domestic Water Piping Specialties."
11. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

    a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

12. Capacities and Characteristics:

    a. Cooled Water: 8 gph.
    b. Ambient-Air Temperature: 90 deg F.
    c. Inlet-Water Temperature: 80 deg F.
    d. Cooled-Water Temperature: 50 deg F.
    e. Electrical Characteristics:

        1) Power: 370 Watts.
        2) Volts: 120-V ac.
        3) Phase: Single.

13. Support: Type I Water Cooler Carrier.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Install fixtures level and plumb.

B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in CSI Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."

D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in CSI Division 22 Section 220518 "Escutcheons for Plumbing Piping."

F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in CSI Division 07 Section 079200 "Joint Sealants."

3.3 CONNECTIONS:

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in CSI Division 22 Section 221116 "Domestic Water Piping."

C. Install ball shutoff valve on water supply to each fixture. Comply with valve requirements specified in CSI Division 22 Section 220523 "General-Duty Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in CSI Division 22 Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING:

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING:

A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by the Engineer.

END OF SECTION 224716

SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Flexible-hose packless expansion joints.
2. Pipe loops and swing connections.
3. Alignment guides and anchors.

1.2 PERFORMANCE REQUIREMENTS:

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Delegated-Design Submittal: For each anchor and alignment guide 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. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Welding certificates.

1.5 QUALITY ASSURANCE:

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS:

A. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Flex Pression Ltd.
b. Flex-Hose Co., Inc.
c. Flexicraft Industries.
d. Mason Industries, Inc.
e. Metraflex Company (The).
f. Unisource Manufacturing, Inc.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.

5. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with weld end connections.

a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.

2.2 ALIGNMENT GUIDES AND ANCHORS:

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Adsco Manufacturing LLC.
   b. Advanced Thermal Systems, Inc.
   c. Flexicraft Industries.
   d. Hyspan Precision Products, Inc.
   e. Metraflex Company (The).

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

   a. Stud: Threaded, zinc-coated carbon steel.
   b. Expansion Plug: Zinc-coated steel.
   c. Washer and Nut: Zinc-coated steel.

5. Concrete and Grout: Comply with requirements in CSI Division 03 Section 033000, “Cast-in-Place Concrete” for formwork, reinforcement, and concrete.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION:

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION:

A. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.

B. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

C. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION:

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one or two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 230516

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES:

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 SLEEVE-SEAL SYSTEMS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CALPICO, Inc.
2. Metraflex Company (The).

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Plastic.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION:

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in CSI Division 07 Section 079200, "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in CSI Division 07 Section 078413, "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION:

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE:

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.
b. Piping NPS 6 and Larger: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:

a. Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Interior Partitions:

a. Galvanized-steel-pipe sleeves.

3.4 GROUT:

A. Refer to CSI Division 03 Section 033000, “Cast in Place Concrete” for non-shrink grout.

END OF SECTION 230517

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Product Certificates: For each type of meter and gage, from manufacturer.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Trerice, H. O. Co.
2. Weiss Instruments, Inc.
3. Weksler Glass Thermometer Corp.

B. Standard: ASME B40.200.

C. Case: Sealed type; stainless steel with 5-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 THERMOWELLS:

A. Thermowells:

1. Manufacturers: Same as manufacturer of thermometer being used.
2. Standard: ASME B40.200.
3. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
4. Material for Use with Copper Tubing: CNR or CUNI.
5. Material for Use with Steel Piping: CRES or CSA.
6. Type: Stepped shank unless straight or tapered shank is indicated.
7. External Threads: For insertion in a pipe fitting, ASME B1.20.1 pipe threads.
8. Internal Threads: To match thermometer connector threads, with ASME B1.1 screw threads.
9. Bore: Diameter required to match thermometer bulb or stem.
10. Insertion Length: Length required to match thermometer bulb or stem.
11. Lagging Extension: Include on thermowells for insulated piping and tubing.
12. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES:

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Trerice, H. O. Co.
    b. Weiss Instruments, Inc.
    c. Weksler Glass Thermometer Corp.

2. Standard: ASME B40.100.
3. Case: Liquid-filled type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS:

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    1. Sisco Manufacturing Company, Inc.
    2. Trerice, H. O. Co.
    3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Self-sealing rubber.

1. Insert material for water service at 20 to 200 deg F shall be chlorosulfonated polyethylene synthetic.
2. Insert material for water service at minus 30 to plus 275 deg F shall be EPDM.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids.

H. Install test plugs in piping tees.

I. Install thermometers in the following locations:

1. Return from each hydronic zone.

J. Install pressure gages in the following locations:

1. Suction and discharge of each pump.

3.2 CONNECTIONS:

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING:

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE:

A. Scale Range for Heating, Hot-Water Piping: 20 to 240 deg F with 2-degree scale divisions.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE:

A. Scale Range for Heating, Hot-Water Piping: 0 to 160 psi.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Bronze swing check valves.
4. Iron swing check valves.
5. Iron, plate-type check valves.

B. Related CSI Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.2 DEFINITIONS:

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. SWP: Steam working pressure.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of valve indicated.

1.4 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.5 QUALITY ASSURANCE:

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Refer to Form 818 Article 1.06.03 and Form 818 Article 1.20-1.06.03 for additional information.

B. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball and plug valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.

C. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES:

A. Refer to Part 3 HVAC valve schedule for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.

2. Vinyl-Covered Handlever: For quarter-turn valves.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES:

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. NIBCO INC.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES:

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Flo Fab Inc.
d. NIBCO INC.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

2.4 BRONZE SWING CHECK VALVES:

A. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. NIBCO INC.
c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: PTFE or TFE.

2.5 IRON SWING CHECK VALVES:

A. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 6, CWP Rating: 200 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Composition.
g. Seat Ring: Bronze.
h. Disc Holder: Bronze.
i. Disc: PTFE or TFE.
j. Gasket: Asbestos free.

2.6 IRON, PLATE-TYPE CHECK VALVES:

A. Class 125, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. NIBCO INC.
c. Sure Flow Equipment Inc.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: API 594.
b. NPS 2-1/2 to NPS 6, CWP Rating: 200 psig.
c. Body Design: Wafer, spring-loaded plates.
d. Body Material: ASTM A 126, gray iron.
e. Seat: EPDM.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION:

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Plate-Type Check Valves: In horizontal or vertical position, between flanges.

3.3 ADJUSTING:

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS:

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or butterfly valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: Ball, or butterfly valves.
4. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with nonmetallic disc.
    b. NPS 2-1/2 and Larger: Iron swing check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 HEATING-WATER VALVE SCHEDULE:

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125 nonmetallic disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 6: 200 CWP, EPDM seat, aluminum-bronze disc.
3. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
4. Iron, Plate-Type Check Valves: Class 125; single or dual plate; resilient seat.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.

B. Related Sections:

1. Division 05 Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Division 23 Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
4. Division 23 Section 233113 "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS:

A. Terminology: As defined in MSS SP-90, “Guidelines on Terminology for Pipe Hangers and Supports,” Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.3 PERFORMANCE REQUIREMENTS:

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

1.4 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Welding certificates.

1.6 QUALITY ASSURANCE:

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 STEEL PIPE HANGERS AND SUPPORTS:

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

B. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

E. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS:

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS:

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS:

A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION:

A. Steel Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

K. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 METAL FABRICATIONS:

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.3 ADJUSTING:

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 PAINTING:

A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 Painting Sections.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE:

A. Specific hanger and support requirements are in CSI Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 6.
2. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 6, from two rods if longitudinal movement caused by expansion and contraction might occur.
3. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 6, from single rod if horizontal movement caused by expansion and contraction might occur.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 6.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 6 if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
2. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
3. C-Clamps (MSS Type 23): For structural shapes.
4. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section Includes vibration and seismic controls for HVAC piping and equipment.

B. Related CSI Requirements:

1. Division 22 Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.2 DEFINITIONS:

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic and wind forces required to select vibration isolators and seismic and wind restraints and for designing vibration isolation bases.

    a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
5. Seismic- and Wind-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
    d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Qualification Data: For professional engineer and testing agency.
2. Welding certificates.
3. Field quality-control reports.

1.5 QUALITY ASSURANCE:

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. Wind-Restraint Loading:

1. Basic Wind Speed: Refer to Structural Drawing No. S-002.
2. Building Classification Category: Refer to Structural Drawing No. S-002.
3. Minimum 10 lb/sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction, and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: Refer to Structural Drawing No. S-002.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: Refer to Drawing No. S-002.

   a. Seismic Design Category: Refer to Structural Drawing No. S-002.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): Refer to Structural Drawing No. S-002.
4. Design Spectral Response Acceleration at 1.0-Second Period: Refer to Structural Drawing No. S-002.

5. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

    a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.2 ELASTOMERIC ISOLATION PADS:

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Isolation Technology, Inc.
    d. Kinetics Noise Control, Inc.
    e. Mason Industries, Inc.
    f. Vibration Eliminator Co., Inc.
    g. Vibration Isolation.
    h. Vibration Mountings & Controls, Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Load-bearing metal plates adhered to pads.

2.3 ELASTOMERIC ISOLATION MOUNTS:

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Isolation Technology, Inc.
    d. Kinetics Noise Control, Inc.
    e. Mason Industries, Inc.
    f. Vibration Eliminator Co., Inc.
    g. Vibration Isolation.

h. Vibration Mountings & Controls, Inc.

2. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS:

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation.
h. Vibration Mountings & Controls, Inc.

2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

a. Housing: Cast-ductile iron or welded steel.
b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS:

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.

b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation.
h. Vibration Mountings & Controls, Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 RESTRAINED-SPRING ISOLATORS:

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation.
h. Vibration Mountings & Controls, Inc.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
b. Top plate with threaded mounting holes or elastomeric pad.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.

4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 PIPE-RISER RESILIENT SUPPORT:

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.8 RESILIENT PIPE GUIDES:

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.9 ELASTOMERIC HANGERS:

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Vibration Eliminator Co., Inc.
g. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.

3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.10 SPRING HANGERS:

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Kinetics Noise Control, Inc.
d. Mason Industries, Inc.
e. Vibration Eliminator Co., Inc.
f. Vibration Isolation.
g. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.11 SNUBBERS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Kinetics Noise Control, Inc.
2. Mason Industries, Inc.
3. Vibration Mountings & Controls, Inc.

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

2.12 RESTRAINT CHANNEL BRACINGS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.13 RESTRAINT CABLES:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Kinetics Noise Control, Inc.
2. Loos & Co., Inc.
3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.14 SEISMIC-RESTRAINT ACCESSORIES:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.

2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. TOLCO.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.15 MECHANICAL ANCHOR BOLTS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.16 ADHESIVE ANCHOR BOLTS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.17 VIBRATION ISOLATION EQUIPMENT BASES:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. California Dynamics Corporation.
2. Kinetics Noise Control.
3. Mason Industries, Inc.
4. Vibration Eliminator Co., Inc.
5. Vibration Isolation.
6. Vibration Mountings & Controls, Inc.

B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Concrete Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.18 RESTRAINED ISOLATION ROOF-CURB RAILS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ace Mountings Co., Inc.
2. California Dynamics Corporation.
3. Kinetics Noise Control.
4. Mason Industries, Inc.
5. Thybar Corporation.

B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.

C. Upper Frame: The upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic and wind forces.

D. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support the upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.

F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and equipment to receive vibration isolation and seismic and wind control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-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.

3.2 APPLICATIONS:

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION:

A. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

B. Comply with requirements in CSI Division 07 Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

C. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

D. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

E. Install cables so they do not bend across edges of adjacent equipment or building structure.

F. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION:

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in CSI Divisions 23 Section 232113 "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL:

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with the Engineer, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Engineer's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by the Engineer.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING:

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 HVAC VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Supported Equipment: Rooftop Unit.

1. Equipment Location: Outdoor.

2. Type: Restrained Vibration Isolation Roof Curb Rails.
3. Minimum Deflection: As required.
4. Component Importance Factor: 1.5.
5. Component Response Modification Factor: 2.5.
6. Component Amplification Factor: 2.5.

B. Supported Equipment: Boilers.

1. Equipment Location: Mechanical Room.
2. Pads:

   a. Material: Neoprene, Rubber, or Hermetically sealed compressed fiberglass.
   b. Thickness: As required.
   c. Number of Pads: As required.

3. Mount: Elastomeric.
4. Base Type: As required.
5. Minimum Deflection: As required.
6. Component Importance Factor: 1.5.
7. Component Response Modification Factor: 2.5.
8. Component Amplification Factor: 1.0.

C. Supported Equipment: Condenser/Floor-Mounted Boiler Expansion Tank.

1. Equipment Location: Outdoor/Mechanical Room.
2. Type: As required.
3. Minimum Deflection: As required.
4. Component Importance Factor: 1.5.
5. Component Response Modification Factor: 2.5.
6. Component Amplification Factor: 2.5.

D. Supported Equipment: Hydronic Pumps, Suspended Fans, Propeller and Cabinet Unit Heaters.

1. Equipment Location: Various.
2. Isolator Type: Elastomeric Hangers, Spring Hangers, or Spring Hangers with Vertical-Limit Stop.
3. Minimum Deflection: As required.
4. Component Importance Factor: 1.5.
5. Component Response Modification Factor: 2.5.
6. Component Amplification Factor: 1.0.

E. Piping Systems, NPS 2 1/2 and larger: Hydronic, Natural Gas.

1. Type: As required.
2. Minimum Deflection: As required.
3. Component Importance Factor: 1.5.
4. Component Response Modification Factor: 2.5.

5. Component Amplification Factor: 1.0.

F. Piping Systems, NPS 2 and smaller: Hydronic, Natural Gas, Refrigerant.

1. Not Required.

G. Ducts.

1. Type: As required.
2. Minimum Deflection: As required.
3. Component Importance Factor: 1.5.
4. Component Response Modification Factor: 6.0.
5. Component Amplification Factor: 2.5.

H. Supported Equipment: Chimneys.

1. Equipment Location: Mechanical Room.
2. Type: As required.
3. Minimum Deflection: As required.
4. Component Importance Factor: 1.5.
5. Component Response Modification Factor: 2.5.
6. Component Amplification Factor: 1.0.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.
6. Warning tags.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 CLOSEOUT SUBMITTALS:

A. Maintenance Data: Include equipment label schedule and valve schedules for each piping system to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE:

A. ASME Compliance: Comply with ASME 13.1 “Scheme for the Identification of Piping Systems” for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION:

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS:

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Blue.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Plan designation or unique equipment number.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance manual and shall be framed and mounted on the wall in the Mechanical Room at a location determined by the Engineer.

2.2 WARNING SIGNS AND LABELS:

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS:

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS:

A. General Requirements for Duct Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction with contact-type, permanent, self-adhesive backing.

B. Letter Color: White.

C. Background Color: As noted in Part 3.5 “Duct Label Installation.”

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Plans, quantity of airflow, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches.

2.5 VALVE TAGS:

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance manual and shall be framed and mounted on the wall in the Mechanical Room at a location determined by the Engineer.

2.6 WARNING TAGS:

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS:

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION:

A. Install or permanently fasten labels on each major item of mechanical equipment and on each minor item of mechanical equipment as directed by the Engineer.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION:

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule: In accordance with ASME A13.1.

3.5 DUCT LABEL INSTALLATION:

A. Install duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For supply-air ducts.
2. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
3. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

C. Locate airflow quantity duct labels, based on the balanced HVAC system, at each diffuser and return grille.

3.6 VALVE-TAG INSTALLATION:

A. Install tags on valves and control devices in piping systems as directed by the Engineer, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape: 2 inches, round.
2. Valve-Tag Color: Natural.
3. Letter Color: Black.

3.7 WARNING-TAG INSTALLATION:

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes testing, adjusting, and balancing for HVAC to produce design objectives.

1.2 DEFINITIONS:

A. AABC: Associated Air Balance Council.

B. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

C. Balance: To proportion flows within the distributed system, including submains, branches, and terminals, according to indicated design quantities

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NEBB: National Environmental Balancing Bureau.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. Report Forms: Test data sheets for recording test data in a logical order.

H. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

I. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

J. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

K. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

L. TAB: Testing, adjusting, and balancing.

M. TABB: Testing, Adjusting, and Balancing Bureau.

N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

O. Test: A procedure to determine quantitative performance of systems or equipment.

P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

1.4 INFORMATIONAL SUBMITTALS:

A. Qualification Data: Submit copies of current valid certificates to show that the TAB firm and TAB supervisor meet the qualifications specified in Part 1.5 "Quality Assurance". This data shall be submitted a minimum of 30 calendar days before the Contractor's schedule anticipates the commencement of TAB work.

B. Contract Documents Examination Report: Submit the Contract Documents review report as specified in Part 3.1 "Examination" a minimum of 30 calendar days before the Contractor's schedule anticipates the commencement of TAB work.

C. Strategies and Procedures Plan: Submit TAB strategies and step-by-step procedures and system readiness reports as specified in Part 3.2 "Preparation" a minimum of 30 calendar days before the Contractor's schedule anticipates the commencement of TAB work. Include a complete set of report forms intended for use on this Project.

D. Certified TAB reports. Submit reports prepared, as specified in this Section, on approved forms certified by TAB firm.

1. Reports shall bear the seal and signature of the certified supervisor.
2. Final Report shall be submitted a minimum of 14 calendar days' before the anticipated "Semi Final Inspection" described in Form 818 Article 1.20-1.08.12 subsection 1.

1.5 QUALITY ASSURANCE:

A. TAB Firm Qualifications: Engage a TAB entity certified by AABC, NEBB, or TABB with AABC, NEBB, or TABB certified supervisors.

B. Conduct a TAB Meeting at the Project Site in compliance with the requirements of Form 818 Article 1.20-1.05.24 subsection 2.

1. Meet with Engineer's representatives on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of the Contractor, TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven calendar days' advance notice of scheduled meeting time and location.
2. Agenda Items:

    a. Submittal distribution requirements.
    b. The Contract Documents examination report.
    c. The TAB plan.
    d. Work schedule and Project-site access requirements.
    e. Coordination and cooperation of trades and subcontractors.
    f. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB firm complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems," NEBB's "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems," or SMACNA's "HVAC Systems – Testing Adjusting and Balancing."

E. Instrumentation Type, Quantity, Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems," NEBB's "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Section II, Required Instrumentation for NEBB Certification or ASHRAE 111, Section 5, "Instrumentation."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 PROJECT CONDITIONS:

A. Systems Operation: All building mechanical systems, including BAS/ATC System, shall be complete and fully operational prior to beginning balancing procedures.

1.7 COORDINATION:

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven calendar days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine the approved submittals for HVAC systems and equipment.

C. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

D. Examine system and equipment installations and verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual CSI Sections have been performed.

E. Examine system and equipment test reports.

F. Examine HVAC system and equipment installations to verify that indicated balancing devices such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

G. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

H. Examine HVAC equipment to ensure that clean air filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers for clean screens and proper perforations.

K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine equipment for installation and properly operating safety interlocks and controls on HVAC equipment.

O. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Temperature sensors and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract.
8. Controller set points are set at indicated design values.
9. Interlocked systems are operating.

10. Changeover from heating to cooling mode occurs according to indicated design values.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated design values.

3.2 PREPARATION:

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational on their own without the need to bypass any part of the system or manually operate any mechanical equipment.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING:

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance," ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specification for this Project.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS:

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in CSI Division 23 Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS:

A. Adjust fans to deliver total indicated design airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

    a. Report the cleanliness status of filters and the time static pressures are measured.
    b. Simulate dirty filter operation and record the point at which maintenance personnel must change the filter.

3. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated design airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

    a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated design airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated design airflows within specified tolerances of indicated design values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS:

A. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated design airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS:

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated design flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
7. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS:

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Verify with the pump manufacturer that this will not damage the pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated design water flow is achieved.

   a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated design flow.

E. Adjust balancing stations to within specified tolerances of indicated design flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated design flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated design flow and proceeding to the station with the lowest percentage over indicated design flow.
3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

G. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS:

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS:

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.11 PROCEDURES FOR MOTORS:

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

3.12 PROCEDURES FOR CONDENSING UNITS:

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.13 PROCEDURES FOR BOILERS:

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.14 PROCEDURES FOR HEAT-TRANSFER COILS:

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.15 PROCEDURES FOR INDOOR-AIR QUALITY MEASUREMENTS:

A. After air balancing is complete and with HVAC systems operating at indicated conditions, perform indoor-air quality testing.

B. Observe and record the following conditions for each HVAC system:

1. The distance between the outside-air intake and the closest exhaust fan discharge, flue termination, or vent termination.

2. Specified filters are installed. Check for leakage around filters.
3. Cooling coil drain pans have a positive slope to drain.
4. Cooling coil condensate drain trap maintains an air seal.
5. Evidence of water damage.
6. Insulation in contact with the supply, return, and outside air is dry and clean.

C. Measure and record indoor conditions served by each HVAC system. Make measurements at multiple locations served by the system if required to satisfy the following:

1. Most remote area.
2. One location for every 5000 sq. ft. (500 sq. m).

D. Measure and record the following indoor conditions for each location two times at two-hour intervals, and in accordance with ASHRAE 113:

1. Temperature.
2. Relative humidity.
3. Air velocity.
4. Concentration of carbon dioxide (ppm).
5. Concentration of carbon monoxide: 9 ppm max.
6. Nitrogen oxides (ppm).
7. Formaldehyde: 0.05 ppm max.
8. Particulates (PM10): 50 micrograms/cubic meter max
9. Total Volatile Organic Compounds: 500 micrograms/cubic meter max

3.16 TOLERANCES:

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.

3.17 REPORTING:

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination," prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.18 FINAL REPORT:

A. General: Prepare a certified written report in letter-quality font on standard bond paper, in three ring binder. Tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of the TAB firm.
3. Project name.
4. Project location.
5. Designer’s name and address.
6. Contractor's name and address.
7. Report date.
8. Signature of certified supervisor of TAB firm who certifies the report.
9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
10. Summary of contents including the following:

    a. Indicated design versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer's name, type, size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.

d. Face and bypass damper settings at coils.
e. Fan drive settings including settings and percentage of maximum pitch diameter.
f. Inlet vane settings for variable-air-volume systems.
g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated Design and Actual Values):

a. Total air flow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Cooling-coil static-pressure differential in inches wg.
g. Heating-coil static-pressure differential in inches wg.
h. Outdoor airflow in cfm.
i. Return airflow in cfm.
j. Outdoor-air damper position.
k. Return-air damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated Design and Actual Values):

a. Air flow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated Design and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

H. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated design air flow rate in cfm.
h. Indicated design velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:

1. Unit Data:

    a. System and air-handling unit identification.
    b. Location and zone.
    c. Apparatus used for test.
    d. Area served.
    e. Make.
    f. Number from system diagram.
    g. Type and model number.
    h. Size.
    i. Effective area in sq. ft.

2. Test Data (Indicated Design and Actual Values):

    a. Air flow rate in cfm.
    b. Air velocity in fpm.
    c. Preliminary air flow rate as needed in cfm.
    d. Preliminary velocity as needed in fpm.
    e. Final air flow rate in cfm.
    f. Final velocity in fpm.
    g. Space temperature in deg F.

J. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, or air-cooled condensing units, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Unit make and model number.
    d. Compressor make.
    e. Compressor model and serial numbers.
    f. Refrigerant weight in lb.
    g. Low ambient temperature cutoff in deg F.

2. Test Data (Indicated Design and Actual Values):

    a. Inlet-duct static pressure in inches wg.
    b. Outlet-duct static pressure in inches wg.
    c. Entering-air, dry-bulb temperature in deg F.
    d. Leaving-air, dry-bulb temperature in deg F.
    e. Condenser entering-water temperature in deg F.
    f. Condenser leaving-water temperature in deg F.
    g. Condenser-water temperature differential in deg F.
    h. Condenser entering-water pressure in feet of head or psig.
    i. Condenser leaving-water pressure in feet of head or psig.
    j. Condenser-water pressure differential in feet of head or psig.
    k. Control settings.

l. Unloader set points.
m. Low-pressure-cutout set point in psig.
n. High-pressure-cutout set point in psig.
o. Suction pressure in psig.
p. Suction temperature in deg F.
q. Condenser refrigerant pressure in psig.
r. Condenser refrigerant temperature in deg F.
s. Oil pressure in psig.
t. Oil temperature in deg F.
u. Voltage at each connection.
v. Amperage for each phase.
w. Kilowatt input.
x. Crankcase heater kilowatt.
y. Number of fans.
z. Condenser fan rpm.
aa. Condenser fan airflow rate in cfm.
bb. Condenser fan motor make, frame size, rpm, and horsepower.
cc. Condenser fan motor voltage at each connection.
dd. Condenser fan motor amperage for each phase.

K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated Design and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.

d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

L. Indoor-Air Quality Measurement Reports for Each HVAC System:

1. HVAC system designation.
2. Date and time of test.
3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
4. Room number or similar description for each location.
5. Measurements at each location.
6. Observed deficiencies.

M. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.19 ADDITIONAL TESTS:

A. Within 240 calendar days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

1. Additional testing shall be performed during the opposite weather season to the greatest extent possible
2. The Contractor shall submit to the Designer its additional testing schedule for approval.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes HVAC duct insulation and accessories.

B. Related CSI Sections:

1. Division 23 Section 230719 "HVAC Piping Insulation."

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.3 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.4 QUALITY ASSURANCE:

A. Source Limitations: Obtain plumbing and HVAC insulation from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less, or FM Approved Class I materials.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION:

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in CSI Division 23 Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and for space required for maintenance.

1.7 SCHEDULING:

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS:

A. Comply with requirements in Part 3 Duct Insulation Schedules for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2.5 "Factory-Applied Jackets."

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

2.2 ADHESIVES:

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS:

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.4 SEALANTS:

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
c. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FACTORY-APPLIED JACKETS:

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 TAPES:

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.7 SECUREMENTS:

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Insulation Pins and Hangers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) AGM Industries, Inc.; CHP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS:

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

   a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS:

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

   1. Comply with requirements in CSI Division 07 Section 078413, "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION:

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 DUCT INSULATION SCHEDULE, GENERAL:

A. Ducts Requiring Insulation:

1. Indoor, supply
2. Indoor, return

B. Items Not Insulated:

1. Factory-insulated flexible ducts.
2. Flexible connectors.
3. Vibration-control devices.
4. Factory-insulated access panels and doors.
5. Exhaust ductwork.

3.7 INDOOR DUCT INSULATION SCHEDULE:

A. Round, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Round, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

C. Rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

D. Rectangular, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

END OF SECTION 230713

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes insulating the following HVAC piping systems:

1. Condensate drain piping, indoors.
2. Heating hot-water piping, indoors.
3. Refrigerant suction and hot-gas piping, indoors and outdoors.

B. Related CSI Sections:

1. Division 23 Section 230713 "Duct Insulation."

1.2 DEFINITIONS:

A. ASJ: All Service Jacket.

B. SSL: Self Sealing Lap.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.4 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.5 QUALITY ASSURANCE:

A. Source Limitations: Obtain plumbing and HVAC insulation from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less, or FM Approved Class I materials.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION:

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in CSI Division 23 Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING:

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS:

A. Comply with requirements in Part 3 Piping Schedules for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in Part 2.5 "Factory-Applied Jackets."

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pittsburgh Corning Corporation; Foamglas.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-

applied FSK jacket. Factory-applied jacket requirements are specified in Part 2.6 "Factory-Applied Jackets."

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. CertainTeed Corp.; SoftTouch Duct Wrap.
   b. Johns Manville; Microlite.
   c. Knauf Insulation; Friendly Feel Duct Wrap.
   d. Manson Insulation Inc.; Alley Wrap.
   e. Owens Corning; SOFTR All-Service Duct Wrap.

I. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Johns Manville; Micro-Lok.
   b. Knauf Insulation; 1000-Degree Pipe Insulation.
   c. Manson Insulation Inc.; Alley-K.
   d. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in Part 2.6 "Factory-Applied Jackets."

2.2 INSULATING CEMENTS:

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Ramco Insulation, Inc.; Super-Stik.

2.3 ADHESIVES:

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS:

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.5 SEALANTS:

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS:

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED JACKETS:

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.8 TAPES:

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.9 SECUREMENTS:

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS:

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

   a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS:

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in CSI Division 07 Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

3.5 GENERAL PIPE INSULATION INSTALLATION:

A. Requirements herein generally apply to all insulation materials except where more specific requirements are specified elsewhere in this Section.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
8. Label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION:

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION:

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION:

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.10 PIPING INSULATION SCHEDULE, GENERAL:

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE:

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

B. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. NPS 1-1/2 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.

b. Flexible Elastomeric: 1 inch thick for piping installed within block wall.

2. NPS 2 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

b. Flexible Elastomeric: 1 inch thick for piping installed within block wall.

C. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1-1/2 inch thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE:

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inches thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE:

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Concealed:

1. None.

C. Piping, Exposed: Wash Bay.

1. PVC: 20 mils thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE:

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:

1. PVC: 30 mils thick.

END OF SECTION 230719

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes all control equipment for HVAC systems and components that form the BAS/ATC System, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. The BAS/ATC Installer shall provide all necessary hardware and software to implement the functions and sequences specified herein and within CSI Division 23 Section 230993, “Sequence of Operations for HVAC Controls” in its entirety. The BAS/ATC Installer shall base its bid on a complete system.

C. Related CSI Sections include the following:

1. Division 23 Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.2 DEFINITIONS:

A. ASC: Application Specific Controllers.

B. ATC: Automatic Temperature Controls.

C. BAS: Building Automation System.

D. DDC: Direct digital control.

E. I/O: Input/output.

F. PC: Personal computer.

G. PID: Proportional plus integral plus derivative.

H. RTD: Resistance temperature detector.

I. VAV: Variable air volume.

1.3 SYSTEM DESCRIPTION:

A. DDC technology shall be used to provide the functions necessary for control of mechanical systems on this Project.

B. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by operator password. Multiple users shall have access to all valid system data. An operator shall be able to simultaneously log onto any on-site workstation on the control system and have access to all appropriate data regardless of any other workstation being active and on-line.

C. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under its own control.

D. Communication between the control panels and all on-site workstations shall be over a high speed network. All nodes on this network shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. ASC shall be constantly scanned by the network controllers to update point information and alarm information.

E. System shall be expandable through the addition of end devices, controllers, and other devices.

1.4 SYSTEM PERFORMANCE:

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction. Reaction time of less than 10 seconds between operator command of an analog object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 30 seconds. Multiple on-site workstations shall receive alarms within 5 seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as 5 seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

    a. Water Temperature: Plus or minus 1 deg F.
    b. Water Flow: Plus or minus 5 percent of full scale.
    c. Water Pressure: Plus or minus 2 percent of full scale.
    d. Space Temperature: Plus or minus 1 deg F.
    e. Ducted Air Temperature: Plus or minus 1 deg F.

f. Outside Air Temperature: Plus or minus 2 deg F.
g. Dew Point Temperature: Plus or minus 3 deg F.
h. Temperature Differential: Plus or minus 0.25 deg F.
i. Relative Humidity: Plus or minus 5 percent.
j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
l. Airflow (Terminal): Plus or minus 10 percent of full scale.
m. Air Pressure (Space): Plus or minus 0.01-inch wg.
n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
o. Carbon Monoxide: Plus or minus 5 percent of reading.
p. Carbon Dioxide: Plus or minus 50 ppm.
q. Electrical: Plus or minus 5 percent of reading.

1.5 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
4. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing the entire BAS/ATC System with all major components identified including, but not limited to, the following fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.

4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:

    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:

    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

1.6 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
2. Qualification Data: For Installer and manufacturer specified in Part 1.9, "Quality Assurance."
3. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in operation, and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS. Include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.

3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.8 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Toner Cartridges: 1 black and 1 color.
2. Laptop Workstation: Turn over prior to the Semi-Final Inspection.

1.9 QUALITY ASSURANCE:

A. Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 818 Article 1.20-1.05.24 subsection 2.

1. The BAS/ATC Installer shall meet with the Electrical Installer before any wiring is started to ensure that all required circuits are provided and shall meet with the Fire Alarm Installer, HVAC Installer, and any other required installers to coordinate the Work.

B. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project. The BAS/ATC Installer shall:

1. Be responsible for the engineering, installation, calibration, and software programming necessary for a complete and fully operational BAS/ATC System.
2. Have a local office within a 50-mile radius of the Project Site staffed with factory-trained engineers capable of providing instruction, routine maintenance, and 24-hour emergency maintenance service on the entire system.
3. Have a 5-year experience record in the design and installation of systems similar in scope and performance to that specified herein.

C. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with ASHRAE 135 for DDC system components.

1.10 DELIVERY, STORAGE, AND HANDLING:

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.11 COORDINATION:

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with CSI Division 28 Section 283111 "Digital, Addressable Fire-Alarm System" to achieve compatibility with equipment that interfaces with that system.

C. Coordinate supply of conditioned electrical branch circuits by the Electrical Installer for control units, system panels, VAV terminal units and dampers, and on-site operator workstation.

D. Coordinate equipment with CSI Division 26 Section 260913 "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

E. Coordinate equipment with CSI Division 26 Section 262416 "Panelboards" to achieve compatibility with starter coils and annunciation devices.

F. Coordinate equipment with CSI Division 26 Section 262419 "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL:

A. All hardware and software developed for this Project shall become the property of the State of Connecticut including, but not limited to, the following: Project graphic images, Record Drawings, project database, and job-specific application programming code.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, the BAS/ATC System shall be Tracer SC as manufactured by Trane. “Or Equal” manufacturers will not be permitted.

B. The BAS/ATC System is required to be in full compliance with all system requirements, including the ability to interface with the Web-based Tracer SC running on all existing workstations. All reports and features described must be interfaced with all existing workstations, and all existing workstations shall be set up by the BAS/ATC Installer to communicate with the Project facility. Wherever the term "existing workstation" is used herein, it shall imply the following:

1. Workstation in Room 2447 of the ConnDOT Headquarters.
2. Workstation in the Maintenance Shop of ConnDOT Headquarters.
3. Workstation at Region 1 Office, Newington.
4. Workstation at District 2, Norwich.
5. Workstation at Region 3 Office, Trumbull.
6. Workstation at Region 3 Office, Litchfield.
7. Laptop workstations carried by field maintenance staff.

These existing workstations have a variety of operating systems including Windows 7.

2.2 DDC EQUIPMENT:

A. On-Site Workstation: Workstation shall be able to access all information in the system. The workstation shall reside on the same high-speed network as the building controllers, and also be able to connect to the system. PC with minimum configuration as follows:

1. Motherboard: With 8 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
2. Processor: Intel Core i5-7500 Quad Core 3.4-GHZ.
3. Random-Access Memory: 32 GB.
4. Graphics: Intel HD graphics 530 –PCIe.
5. Display: 24 inches, WUXGA+, minimum 1920 x 1200 resolution.
6. Keyboard: Microsoft Keyboard.
7. Hard-Disk Drive: 512 GB.
8. CD-ROM Read/Write Drive: 24x CD-RW/DVD-RW Combo Drive.
9. Mouse: 2 button.
10. Uninterruptible Power Supply (UPS): Manufactured by Tripp-Lite, or an approved equal. UPS shall be sized according to BAS system demands. UPS shall be installed in a lockable cabinet.
11. Operating System: Microsoft Windows 7.

    a. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

12. All required serial, parallel, and network communication ports, and all cables for proper system operation.

13. Software: Antivirus Protection, and hyperterminal for Windows. All software shall be pre-loaded onto the workstation. The workstation manuals, software manuals, software registration cards, licenses, and original CD-ROMS shall be turned over to the Engineer.
14. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work are limited to the following:

    a. Hewlett-Packard.
    b. Dell.

15. Printer: Color, ink-jet type as follows:

    a. Print Head: 4800 x 1200 dpi optimized color resolution.
    b. Paper Handling: Minimum of 100 sheets.
    c. Print Speed: Minimum of 17 ppm in black and 12 ppm in color.
    d. Printer shall be manufactured by Hewlett Packard, or an approved equal.

B. Laptop Workstation: The laptop workstation will allow the user to view and acknowledge alarms, access and edit system database information, view system graphical displays and reports, and customize the BAS/ATC System. Separate point groups for hydronic heat, bay temperatures, rooftop units, unit ventilators, and office temperatures shall be designed as custom graphical displays and have setpoints controlled on screen. Laptop computer with heavy-duty canvas notebook computer carrying bag and strap with minimum configuration as follows:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Latitude 5290 2-in-1 as manufactured by Dell or an approved equal:
2. System: With integrated USB 3.1 port, two USB Type-C ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
3. Processor: Intel Core i5-8350U Quad Core 1.7-GHZ.
4. Random-Access Memory: 16-GB.
5. Display: 12.3 inches, color touchscreen, WUXGA+, minimum 1920 x 1200 resolution.
6. Keyboard: Microsoft Keyboard.
7. Hard Drive: 512-GB solid state drive.
8. Intel Dual-Band 8265 Wireless Card.
9. Battery: Primary 3 cell, 31.5W/hr battery pack. Include a 65W AC power adapter.
10. Operating System: Microsoft Windows 7.

    a. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

C. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply

shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

2.3 SOFTWARE, GENERAL:

A. System Graphics: The operator workstation software shall be graphically oriented. The system shall allow display of up to 10 graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen. The System graphics shall be able to be modified while on line. An operator with the proper password level shall be able to add, delete, or change dynamic points on a graphic. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation by shifting image files based on the status of the point.

1. Custom Graphics: Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in industry standard formats (such as PCX, TIFF, and GEM). The graphics generation package shall also provide the capability of capturing or converting graphics from other programs such as MicroStation SE.
2. Graphics Library: Furnish a complete library of standard HVAC equipment such as chillers, boilers, air handlers, terminal units, fan coils, and unit ventilators. This library shall also include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.
3. Engineering Units: Standard Inch Pound.
4. On-Site Workstations shall contain port cards to directly access Summit at the Project Site without a phone line plus and internal modem for remote dial-up access.
5. System Applications: Workstation shall provide operator interface and off-line storage of system information. Provide the following applications at each workstation:

    a. Automatic System Database Save and Restore: Each workstation shall store on the hard disk a copy of the current database of each building controller. This database shall be updated whenever a change is made in any panel in the system. The storage of this data shall be automatic and not require any operator input. In the event of a database loss in a building management

panel, the first workstation to detect the loss shall automatically restore the database for that panel.

b. Manual Database Save and Restore: A system operator with the proper password clearance shall be able to archive the database from any system panel and store on magnetic media. The operator shall also be able to clear a panel database and manually initiate a download of a specified database to any panel in the system.

c. System Configuration: The workstation software shall provide a graphical method of configuring the system. The user with proper security shall be able to add new devices, assign modems to devices, and obtain a visual riser diagram of the system. This shall allow for future system changes or additions.

d. On-Line Help: Provide a context sensitive, on line help system to assist the operator in operating and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.

e. Security: Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto logoff time shall be set per operator password. All system security data shall be stored in an encrypted format.

f. System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

g. Alarm Processing: Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.

    1) Alarm Reactions: The operator shall be able to determine what actions, if any, are to be taken, by object (or point), during an alarm. Actions shall include logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, providing audible annunciation or displaying specific system graphics. Each of these actions shall be configurable by workstation and time of day. An object in alarm that has not been acknowledged within an operator-specified time period shall be re-routed to an alternate operator specified alarm receipt device.

    2) Binary Alarms: Each binary object shall be set to alarm based on the operator-specified state. Provide the capability to disable alarming when the associated equipment is turned off or is being serviced.

3) Analog Alarms: Each analog object shall have both high and low alarm limits and warning limits. Alarming must be able to be automatically and manually disabled.

h. Trend Logs: The operator shall be able to define a custom trend log for any data in the system. This definition shall include interval, start-time, and stop-time. Trend intervals of 1-, 5-, 15-, 30-, and 60-minutes as well as once a shift (8-hours), once a day, once a week, and once a month shall be selectable. All trends shall start based on the hour. Each trend shall accommodate up to 64 system objects. The system operator with proper password shall be able to determine how many samples are stored in each trend. Trend data shall be sampled and stored on the Building Controller panel and be archived on the hard disk. Trend data shall be able to be viewed and printed from the operator interface software and storable in a tab-delimited ASCII format for use by other industry standard word processing and spreadsheet packages.

i. Alarm and Event Log: The operator shall be able to view all logged system alarms and events from any location in the system. Events shall be listed chronologically. An operator with the proper security level may acknowledge and clear alarms. All that have not been cleared by the operator shall be archived to the hard disk on the workstation.

j. Object and Property Status and Control: Provide a method for the operator with proper password protection to view, and edit if applicable, the status of any object and property in the system. These statuses shall be available by menu, on graphics, or through custom programs.

k. Clock Synchronization: The real time clocks in all building control panels and workstations shall be synchronized on command of an operator. The system shall also be able to automatically synchronize all system clocks daily from any operator-designated device in the system. The system shall automatically adjust for daylight savings and standard time if applicable.

l. Reports and Logs: Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer.

1) Custom Reports: Provide the capability for the operator to easily define any system data into a daily, weekly, monthly, or annual report. These reports shall be time and date stamped and shall contain a report title and the name of the facility.

2) Standard Reports: The following standard system reports shall be provided. The Owner can readily customize these reports.

a) Electrical Meter Report: Provide a monthly report showing the daily electrical consumption and peak electrical demand for each building meter. Provide an annual (12 month) summary report showing the monthly peak demand and electrical consumption for each meter.

b) Weather Data Report: Provide a monthly report showing the daily minimum, maximum and average outdoor air temperature and the number of heating and cooling degree days for each day. Provide an annual (12 month) report showing the minimum, maximum and average outdoor air temperature for the month and the number of heating and cooling degree days for the month.

c) Tenant Override Reports: For each tenant, provide a monthly report showing the daily total time (in hours) that after-hours HVAC and lighting services were requested. Provide an annual summary report that shows the override usage on a monthly basis.

B. Workstation Applications Editors: Each workstation shall support full screen editing of all system applications. Provide editors for each application at the workstation. The applications shall be downloaded and executed at the appropriate controller panels.

1. Controller: Provide a full screen editor for each type controller and application, that shall allow the operator with proper password to view and change the configuration, name, control parameters, and system setpoints.
2. Schedule: An editor for the scheduling application shall be provided at each workstation. Provide a monthly calendar for each schedule. Exception schedules and holidays shall be shown clearly on the calendar. Provide a method for allowing several related objects to follow a schedule. The advance and delay time for each object shall be adjustable from this master schedule.

   a. An operator with proper password level shall be able to modify the schedule. Schedules shall be able to be easily copied between objects and dates.

3. Equipment Coordination: Provide a full screen editor that allows equipment to be grouped for proper operation as specified in the sequence of operations. This shall include the coordination of VAV terminal units and dampers with their associated air handling unit/rooftop unit.
4. Custom Application Programming: Provide the tools to create, modify, and debug custom application programming. The operator shall be able to create, edit, and download custom programs at the same time that all other system applications are operating. The system shall be fully operable while custom routines are edited, compiled, and downloaded. The programming language shall have the following features:

a. The language shall be English language, oriented and based on the syntax of programming languages, such as BASIC. It shall allow for free form or fill in the blank programming. Alternatively, the programming language can be graphically-based using function blocks as long as blocks are available that directly provide the functions listed below, and that custom or compound function blocks can be created.
b. A full screen character editor/programming environment shall be provided. The editor shall be cursor/mouse-driven and allow the user to insert, add, modify, and delete code from the custom programming. It shall also incorporate word processing features such as cut/paste and find/replace.
c. The programming language shall allow independently executing program modules to be developed. Each module shall be able to independently enable and disable other modules.
d. The editor/programming environment shall have a debugging/simulation capability that allows the user to step through the program and to observe any intermediate values and or results. The debugger shall also provide error messages for syntax and execution errors.
e. The programming language shall support conditional statements (IF/THEN/ELSE/ELSE-IF) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
f. The programming language shall support floating-point arithmetic using the following operators: +, -, /, x, square root, and xy. The following mathematical functions shall also be provided: natural log, log, absolute value, and minimum/maximum value from a list of values.
g. The programming language shall have pre-defined variables that represent clock time, day of the week, and date. Variables that provide interval timing shall also be available. The language shall allow for computations using these values.
h. The programming language shall have ability to pre-defined variables representing the status and results of the System Software, and shall be able to enable, disable, and change the values of BACnet objects in the system.

2.4 SYSTEM SOFTWARE:

A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.

B. System Security:

1. User access shall be secured using individual security passwords and user names.
2. Passwords shall restrict the user to only the objects, applications, and system functions as assigned by the system manager.
3. User logon/logoff attempts shall be recorded.

4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.

C. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to 10 events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:

1. Weekly Schedule: Provide separate schedules for each day of the week.
2. Exception Schedule: Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
3. Holiday Schedule: Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
4. Optimal Start/Stop: The scheduling application outlined above shall support an optimal start/stop algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less then and greater than 24-hours. Provide the ability to modify the start/stop algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.

D. Alarm Reporting: The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions. An alarm shall be able to start programs, be logged in the event log, printed, generate custom messages and display graphics.

E. Remote Communications: The system shall have the ability to dial out in the event of an alarm. Receivers shall include PC Workstations, and Alpha-numeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system using dial up communications in the same format and method used on site under Part 2.2, “DDC Equipment.”

F. Demand Limiting:

1. The demand limiting program shall monitor building power consumption from signals generated by a pulse generator (provided by others) mounted at the building power meter, or from a watt transducer or current transformer attached to the building feeder lines.

2. The demand limiting program shall be based on a predictive sliding window algorithm. The sliding window duration and sampling interval shall be set equal to that of the local Electrical Utility.
3. Control system shall be capable of demand limiting by resetting HVAC system set-points to reduce load while maintaining Indoor Air Quality (humidity, VOC, carbon dioxide) and comfort control in the space.
4. Input capability shall also be provided for an end-of-billing period indication.

G. Maintenance Management: The system shall monitor equipment status and generate maintenance messages based upon user designated run time, starts, and/or calendar date limits.

H. PID Control: A PID algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs. The controlled variable, setpoint, and PID gains shall be user-selectable. The setpoint shall optionally be chosen to be a reset schedule.

I. Staggered Start: This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts shall be user-selectable.

J. System Calculations: Provide software to allow instantaneous power (e.g. kW), flow rates (e.g. GPM) to be accumulated and converted to energy usage data. Provide an algorithm that calculates a sliding-window kW demand value. Provide an algorithm that calculates energy usage and weather data (heating and cooling degree days). These items shall all be available for daily, previous day, monthly and the previous month.

K. Anti-Short Cycling: All binary output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.

2.5 SYSTEM APPLICATION CONTROLLERS:

A. General: Provide Building Controllers to provide the performance specified herein. Each of these panels shall meet the following requirements:

1. The BAS shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the global strategies described in Part 2.4, “System Software.”
2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
3. The controller shall provide a communications port for connection of the Portable Operators Terminal using Point to Point BACnet physical/data link layer protocol or a connection to the inter-network.
4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.

5. Controllers that perform scheduling shall have a real time clock.
6. Data shall be shared between networked Building Controllers.
7. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

    a. Assume a predetermined failure mode.
    b. Generate an alarm notification.

8. The Building Controller shall be a BACnet Class 3 device and perform the following BACnet Functional Group Services: Clock, Reinitialize.

B. Communications: Each Building Controller shall reside on a BACnet inter-network using the ISO 8802-3 (Ethernet) Physical/Data Link layer protocol. Each Building Controller shall also perform routing to a network of Custom Application and Application Specific Controllers.

C. Environment: Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at 32- to 120°F.

D. Serviceability: Provide diagnostic LED's for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.

E. Memory: The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72-hours.

F. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

2.6 CUSTOM APPLICATION CONTROLLERS:

A. General: Provide Custom Application Controllers to provide the performance specified herein. Each of these panels shall meet the following requirements:

1. The BAS shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the local strategies described in Part 2.4, "System Software."
2. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.
3. Controllers that perform scheduling shall have a real time clock.
4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
5. Data shall be shared between networked Controllers.

6. The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

    a. Assume a predetermined failure mode.
    b. Generate an alarm notification.

B. Environment: Controller hardware shall be suitable for the anticipated ambient conditions.

    1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA Type 4 waterproof enclosures, and shall be rated for operation at - 40- to 150°F.
    2. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32- to 120°F.

C. Keypad: A local keypad and display shall be provided where specified in the sequence of operations or points list. Keypad shall be provided for interrogating and editing data. An optional system security password shall be available to prevent unauthorized use of the keypad and display.

D. Serviceability: Provide diagnostic Leeds for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.

E. Memory: The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72-hours.

F. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

2.7 APPLICATION SPECIFIC CONTROLLERS:

A. General: ASC are microprocessor-based DDC controllers that through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.

    1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
    2. Each ASC will contain sufficient I/O capacity to control the target system.

B. Environment: The hardware shall be suitable for the anticipated ambient conditions.

    1. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA Type 4 waterproof enclosures, and shall be rated for operation at - 40- to 150°F.
    2. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32- to 120°F.

C. Serviceability: Provide diagnostic LED's for power, and communications. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.

D. Memory: The ASC shall maintain all BIOS and programming information in the event of a power loss for at least 90 days.

E. Immunity to Power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.

F. Transformer: Power supply for the ASC must be rated at minimum of 125% of ASC power consumption, and shall be fused or current limiting type.

2.8 COMMUNICATIONS:

A. Each BACnet device shall operate on the BACnet physical/data link protocols specified for that device as defined in this Section.

B. The BAS/ATC Installer shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the inter-network.

C. All Building Controllers shall have a communications port for connections with the operator interfaces. This may be either an RS-232 port for Point to Point connection or a network interface node for connection to the Ethernet or ARCNET network.

D. Remote operator interface via a 33,600-baud or faster modem shall allow for communication with any and all controllers on this network as described in PART 2.8F below.

E. Communications services over the inter-network shall result in operator interface and value passing that is transparent to the inter-network architecture as follows:

1. Connection of an operator interface device to any one controller on the inter-network will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the inter-network.
2. All database values (i.e., points, software variable, and custom program variables) of any one controller shall be readable by any other controller on the inter-network. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform inter-network value passing.

F. The time clocks in all controllers shall be automatically synchronized daily.

2.9 INPUT/OUTPUT INTERFACE:

A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or ASC.

B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24-V of any duration, such that contact with this voltage will cause no damage to the controller.

C. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12-ma to be compatible with commonly available control devices.

D. Pulse accumulation input points. This type of point shall conform to all the requirements of binary input points, and also accept up to 2 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.

E. Analog inputs shall allow the monitoring of low voltage (0-10-Vdc), current (4-20-ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

F. Binary outputs shall provide for on/off operation, or a pulsed low voltage signal for pulse width modulation control. Binary outputs on custom and building controllers shall have 3-position (on/off/auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.

G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10-Vdc or a 4-20-ma signal as required to provide proper control of the output device. Analog outputs on building or custom programmable controllers shall have status lights and a 2-position (auto/manual) switch and manually adjustable potentiometer for manual override.

2.10 ELECTRONIC SENSORS:

A. Description: Vibration and corrosion resistant; for wall, immersion, strap-on, or duct mounting as required.

B. Thermistor and RTD Temperature Sensors and Transmitters:

1. Accuracy: Plus or minus 0.5 deg F at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements in Ducts: Single point, 6 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
4. Averaging Elements in Ducts: 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.

5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
6. Space Sensors: Non-adjustable unless otherwise noted, with override button where shown on the Plans.
7. Weatherproof Space Sensors: Watertight inlet fitting.
8. Outdoor-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Strap-On Sensors: Sealed element with an adjustable pipe clamp.
10. Concrete Slab Sensors: For use in conduits, soils, and concrete.

C. Pressure Transmitters/Transducers:

1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.

a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
b. Duct Static-Pressure Range: 0- to 5-inch wg.

2.11 STATUS SENSORS:

A. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements, Model No. H-708, as manufactured by Hawkeye, or an approved equal.

B. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

C. Water-Flow Switches: Snap-acting type with pilot-duty rating (125-VA minimum), stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure, unless otherwise specified.

D. Flow Switches (Air or Water Service): Differential-pressure type, UL-listed, SPDT snap-acting type with pilot duty rated (125-VA minimum), NEMA Type 1 enclosure, with scale range and differential suitable for intended application, or as specified.

1. Current sensing relays may be used for flow sensing on terminal devices.

E. Door Position Switches: Wide-gap magnetic type, waterproof and encapsulated with an armored cord, Model No. 2202AU, as manufactured by GE Security, or an approved equal.

2.12 GAS DETECTION EQUIPMENT:

A. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output;, for wall mounting.

2.13 THERMOSTATS:

A. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet.

B. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet.

2.14 ACTUATORS:

A. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Dampers: Size for running torque calculated as follows:

a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.

2. Coupling: V-bolt and V-shaped, toothed cradle.
3. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
4. Fail-Safe Operation: Mechanical, spring-return mechanism.
5. Power Requirements: 24-V ac.
6. Electronic Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal
7. Auxiliary switch: Built-in, UL-listed, SPDT.

2.15 CONTROL VALVES:

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated with equal percentage ports or ball configuration for modulating service.

1. Control valves shall be two-way or three-way type for two-position or modulating service as scheduled or shown.

B. Hydronic system valves shall have the following characteristics:

1. NPS 2 and Smaller: Class 250 bronze body or cast brass body, bronze trim, spring loaded, PTFE packing, quick-opening for two-position service. Two-way valves to have renewable composition disc or stainless steel ball.
2. NPS 2-1/2 and Larger: Class 125 iron body, with guided plug and PTFE packing.

3. Sizing: 3-psig maximum pressure drop at design flow rate or the following:

   a. Two Position: Line size.
   b. Two-Way Modulating: Either the value specified above, twice the load pressure drop, or 50% of the pressure difference between supply and return mains, whichever is more.
   c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.

4. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide the following minimum close-off pressure ratings:

   a. Two-way: 150% of total system (pump) head.
   b. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

C. Water valves shall fail normally open or closed as follows:

1. Hot water zone valves: Normally open
2. Heating coils in air handlers: Normally open.
3. Perimeter radiation valves: Normally closed.
4. Other applications: As required by sequence of operation.

2.16 DAMPERS:

A. General: The BAS/ATC Installer shall provide all automatic control dampers not specified to be supplied integral to the HVAC equipment.

B. Dampers, VAV: Minimum 22-gauge galvanized steel blades, with an integral 24-VAC electric actuator. Dampers shall operate at static pressures up to 1.75-inches wg. Wide-open damper pressure drop shall be less than 0.05-inches at 2000-feet per minute.

1. Casing: Casing shall be fabricated from a minimum of 18-gauge aluminized steel.
2. Drivetrain: Worm gear molded directly onto motor shaft, with integral microswitches to stop motor at the fully open and fully closed positions, with a maximum open to close drive time of 60-seconds.
3. Dampers shall be VariTrac Air Damper Model VADB, as manufactured by The Trane Co., or an approved equal.

2.17 AIR TERMINAL UNITS:

A. Single Duct Air Terminal Units, VAV: Minimum 18-gauge corrosion protected steel on the inlet side of the damper and 22-gauge on the low pressure side, with actuator for direct digital control. Air Terminal Units shall be capable of maintaining airflow within +/- 5 percent of rated unit airflow setpoint.

1. Casing: Casing shall be fabricated from a minimum 22 gauge corrosion protected steel.
2. Insulation: The interior surface of unit casing shall be lined with a minimum of ½ inch, 2.0 lb./cu/ ft. density, 2.2 minimum R-Value, glass fiber with foil facing.
3. Drivetrain: Damper actuator shall be a three wire 24-VAC motor.
4. Flow Sensor: Integral flow sensor shall be multi-point, averaging, ring or cross type.
5. Air Terminal Units shall be VariTrane Variable Air Volume Unit Model VCCF, as manufactured by The Trane Co., or an approved equal.

2.18 RELAYS:

A. Control relays shall be UL listed plug-in type with dust cover or totally enclosed with condulet fitting. Contact rating, configuration, and coil voltage suitable for application.

B. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from setpoint required by the sequence of operation. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA Type 1 enclosure when not installed in local control panel.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify that power supply is available to control units, system panels, VAV terminal units and dampers, and operator workstation.

B. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

C. The BAS/ATC Installer shall notify the Engineer of any discrepancies, conflicts, or omissions prior to commencing rough-in work.

3.2 INSTALLATION:

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Install sensors where shown on the Plans in accordance with manufacturer's recommendations.

1. Mount sensors rigidly and adequate for the environment within which the sensor operates.
2. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing. Insulate junction boxes.
3. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
4. Install duct static pressure tap with tube end facing directly down-stream of airflow.
5. Sensors used in mixing plenums, and hot and cold ducts shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
6. Pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.
7. Strap-on temperature sensors shall be mounted on the pipe with thermal conductive compound to ensure proper heat transfer and a true temperature reading.

D. Control Dampers: Install in accordance with manufacturer's instructions for field installation along with the following:

1. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure ¼-inch larger than damper dimensions and shall be square, straight, and level.
2. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be equal ±1/8-inch.
3. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
4. Install extended shaft or jackshaft per manufacturer's instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)
5. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to assure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
6. Provide a visible and accessible indication of damper position on the drive shaft end.
7. Support ductwork in area of damper when required to prevent sagging due to damper weight.
8. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

E. Actuators (Valves and Dampers): Install in accordance with manufacturer's instructions along with the following:

1. Actuators shall be mounted on valves with adapters approved by the actuator manufacturer.

2. To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5 degrees open position, manually close the damper, and then tighten the linkage.
3. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

F. Install labels and nameplates to identify control components according to CSI Division 23 Section 230553 "Identification for HVAC Piping and Equipment."

1. Permanently label or code each point of field terminal strips to show the instrument or item served.
2. Identify control panels with laminated plastic nameplates.
3. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.
4. Affix plastic labels on each starter and equipment automatically controlled through the System. Label shall indicate the following:

C A U T I O N This equipment is operating under automatic control and may start at any time without warning.

G. Install hydronic instrument wells, valves, and other accessories according to Section CSI Division 23 232116 Hydronic Piping Specialties."

1. Control Valve Installation: Install in accordance with manufacturer's instructions along with the following:

   a. All control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position.
   b. Control valves shall be installed so that they are accessible and serviceable, and such that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
   c. Isolation valves shall be installed such that control valve body may be serviced without draining the supply/return side piping system. Unions shall be installed at all connections to screwed type control valves.

2. Flow Switch Installation: Install in accordance with manufacturer's instructions along with the following:

   a. Install using a thread-o-let in steel pipe. In copper pipe use C x C x F Tee, no pipe extensions or substitutions allowed.
   b. Mount a minimum of 5 pipe diameters upstream and 5 pipe diameters downstream or 24-inches, whichever is greater, from fittings and other obstructions.
   c. Assure correct flow direction and alignment.

d. Mount flow switch on the top of the pipe, in the horizontal piping.

H. Install refrigerant instrument wells, valves, and other accessories according to CSI Division 23 Section 232300 "Refrigerant Piping."

I. Install duct volume-control dampers according to CSI Division 23 Sections specifying air ducts.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION:

A. Install raceways, boxes, and cabinets according to CSI Division 26 Section 260533 "Raceways and Boxes for Electrical Systems." Where the requirements of this Section differ, the requirements herein shall take precedence.

B. Install building wire and cable according to CSI Division 26 Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Where the requirements of this Section differ, the requirements herein shall take precedence.

C. Size of conduit and size and type of wire shall be the responsibility of the BAS/ATC Installer in accordance with the manufacturer's recommendations, and the NEC.

D. All BAS/ATC 100V power (workstation, panels, etc) shall be protected by the UPS system.

E. Wiring for space sensors shall be concealed in conduit in building walls. All wiring shall be installed as continuous lengths, where possible. Splices shall be made at devices only or within an approved junction box or other approved protective device in a location approved by the Engineer.

F. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

G. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

H. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

I. Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:

1. Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
2. All cables shall be UL listed for application (i.e. cables used in ceiling plenums shall be UL listed specifically for that purpose).

J. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

K. Install control and interlock wiring according to the following:

1. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the BAS/ATC Installer shall provide step down transformers.
2. BAS/ATC Installer shall terminate all control and/or interlock wiring.

L. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.

M. Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.

N. Connect auto/override selector switches to override automatic interlock controls when switch is in hand position.

3.4 CONTROLLERS:

A. Provide a separate Controller for each major piece of HVAC equipment. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.

B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.

C. Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional controller boards or point modules shall be required to implement use of these spare points.

3.5 PROGRAMMING:

A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.

B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

C. Software Programming: Provide all programming necessary, whether stated specifically herein or not, for the intended operation of the system. Adhere to the strategy algorithms provided. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in CSI Division 23 Section 230993, "Sequence of Operations for HVAC Controls."

D. Operators' Interface:

1. Standard Graphics: Provide graphics for each major piece of equipment and floor plan in the building including, but not limited to, each Rooftop Unit, VAV Terminal, Fan Coil and Boiler. These standard graphics shall show all points dynamically as specified in the Points List. All graphics installed on the site workstation must also be installed and tested on all existing Windows-based workstations.
2. The BAS/ATC Installer shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described herein, including any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.
3. The BAS/ATC Installer will perform a complete test of the operator interface. Test duration shall be a minimum of 8-hours on-site. Tests shall be made in the presence of the Engineer.

3.6 FIELD QUALITY CONTROL:

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test each point through its full operating range to verify that safety and operating control set points are as required.
4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
5. Test each system for compliance with sequence of operation.
6. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.

2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

E. The BAS/ATC System will not be accepted until an acceptance test is performed in the presence of the Engineer and the Owner to ensure the proper operation of the entire BAS/ATC System, and until the outcome is acceptable to the Engineer and the Owner. The BAS/ATC Installer shall dedicate a minimum of 8 hours on-site for this acceptance test.

3.7 ADJUSTING:

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.

d. Check digital outputs using ohmmeter to test for contact making or breaking.
e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of issuance of the Certificate of Compliance, provide on-site assistance in adjusting system to suit actual occupied conditions. This includes a one-time backup of all databases and archival 11 months after the issuance of the Certificate of Compliance. Provide up to three visits to the Project Site during other than normal occupancy hours for this purpose at no additional cost to the State.

3.8 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. When the BAS/ATC System is 100% operational, engage a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, maintaining equipment and schedules; creating, modifying, and deleting programming; adding, removing, or modifying physical points of the system; and adding additional panels to the system.

1. These objectives will be divided into 3 logical groupings. Participants may attend one or more of these groupings, depending on their required level of knowledge:

   a. Day-to-Day Operators.
   b. System Troubleshooter.
   c. System Manager.

2. Provide training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs.
3. Include a minimum of (2) 8-hour dedicated instructor training sessions, one of which is to be held at the Project Site and the other is to be held at the BAS/ATC Installer's local office and shall include workstation access for all participants along with the ability to view and control the Project's BAS/ATC System. The instructor shall videotape training sessions.
4. Provide a copy of all training materials to each participant. Provide a "Daily Operators Training" CD-ROM and a copy of the videotape for continued use by the Owner after the formal training has been concluded.

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes control sequences for HVAC systems, subsystems, and equipment as well as control sequences for other building systems.

B. The BAS/ATC Installer shall base its bid on a complete system.

C. Related CSI Sections include the following:

1. Division 23 Section 230900 "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

1.2 DEFINITIONS:

A. BCU: Building Control Unit.

B. DDC: Direct digital control.

C. UCP: Unit Control Panel.

D. SC: System Controller.

E. VAV: Variable air volume.

1.3 SYSTEM CONTROL:

A. The building systems shall be locally and remotely monitored and controlled by a direct digital BAS.

1. Local Access: The local access shall be a computer to interface with Tracer SC, as specified in CSI Division 23 Section 230900, “Instrumentation and Control for HVAC.”
2. Remote Access: The remote access shall be accomplished from all existing workstation locations specified in Part 2.1B of CSI Division 23 Section 230900, “Instrumentation and Control for HVAC.”

B. The system as installed must be capable of interface with the Tracer SC. A minimum of 10 custom graphical displays shall be designed for each system as directed by the Owner and shall be installed at each new and existing workstation.

C. The information displayed by the graphics shall be through web-based access at each new and existing workstation. A minimum of 8 additional Building Graphics shall be developed and installed at each new and existing workstation to allow remote control of the Facility.

D. The SC shall be programmed to provide occupied and unoccupied control of all HVAC systems and equipment, and shall automatically switch between modes on a preset and adjustable time schedule, as determined by the Owner.

1. During the unoccupied period, depressing and holding the override button located on the space sensor in Maintenance Clerk's Office and Repair Office for 5 seconds will start all HVAC systems and equipment returning the building to the occupied mode for a preset and adjustable time period, unless otherwise noted.
2. If additional occupied time is required, pushing the override button again will reset the time remaining to the maximum.
3. Once the normal occupied mode start time is reached, the SC shall automatically disable the override, reset the timer to zero, and resume normal occupied mode.

1.4 HEATING CONTROL SEQUENCES:

A. Hydronic Supply Temperature Control: The UC600 shall enable the lead boiler when hot water is required by any building system for heat. Once enabled, the boiler shall operate on its own self-contained controls until the hot water supply temperature achieves the desired setpoint, based on the reset schedule. At this point, the UC600 shall disable the boiler until the water temperature drops 5° below setpoint, at which time the boiler shall be re-enabled. The UC600 shall rotate the boilers on a weekly basis to maintain equal run-time, and shall monitor the operational status of the boilers and pass their status to the SC. If either boiler is manually overridden at the boiler by the local 2-position auto/override switch (installed by the BAS/ATC Installer), an alarm will be generated at the SC.

1. Reset Schedule (Adjustable): Control hydronic supply temperature in straight-line relationship to outdoor temperature for the following conditions:

a. 200°F water temperature when outdoor air temperature is 0°F.
b. 140°F water temperature when outdoor air temperature is 60°F.

2. Control of Circulating Pumps: Energize pumps, including the secondary boiler circulating pumps, at outdoor air temperatures below 60°F (adjustable) during the occupied times and below 40°F (adjustable) during the unoccupied times. Pumps shall be energized in sequence with a one-minute delay between each pump start-up, as required. Once the pumps are operational, the UC600 shall monitor the water supply and return temperature and shall send an alarm to the SC if the temperature drops below the active low limit supply temperature setpoint.

B. If either boiler fails to operate as sensed by the water supply immersion sensor or by boiler lockout, the UC600 shall energize an alarm light located in Maintenance Clerk's Office or Repair Office and shall message selected workstations and pagers.

C. Points List (REPAIR):

1. Outdoor Air Temperature.
2. Water Supply Temperature.
3. Water Return Temperature.
4. Boiler 1 Enable/Disable.
5. Boiler 2 Enable/Disable.
6. Boiler 1 Status.
7. Boiler 2 Status.
8. Boiler 1 Override Status Switch.
9. Boiler 2 Override Status Switch.
10. Remote Alarm Light.
11. Pump C1 Enable/Disable.
12. Pump C2 Enable/Disable.
13. Pump C3 Enable/Disable.
14. Pump C4 Enable/Disable.
15. Pump C5 Enable/Disable.
16. Pump C6 Enable/Disable.
17. Pump C7 Enable/Disable.
18. Pump C1 Status.
19. Pump C2 Status.
20. Pump C3 Status.
21. Pump C4 Status.
22. Pump C5 Status.
23. Pump C6 Status.
24. Pump C7 Status.
25. Combustion Air Louver Position Status.

D. Points List (MAINTENACE):

1. Outdoor Air Temperature.
2. Water Supply Temperature.
3. Water Return Temperature.
4. Boiler 1 Enable/Disable.
5. Boiler 2 Enable/Disable.
6. Boiler 1 Status.
7. Boiler 2 Status.
8. Boiler 1 Override Status Switch.
9. Boiler 2 Override Status Switch.
10. Remote Alarm Light.
11. Pump C1 Enable/Disable.
12. Pump C2 Enable/Disable.
13. Pump C3 Enable/Disable.

14. Pump C4 Enable/Disable.
15. Pump C5 Enable/Disable.
16. Pump C6 Enable/Disable.
17. Pump C1 Status.
18. Pump C2 Status.
19. Pump C3 Status.
20. Pump C4 Status.
21. Pump C5 Status.
22. Pump C6 Status.
23. Combustion Air Louver Position Status.

1.5 VARIABLE-AIR-VOLUME AIR-HANDLING-UNIT CONTROL SEQUENCES:

A. General:

1. The rooftop unit will be started and stopped via on board factory controls. Time of day schedules will be determined by the owner.
2. Local hand-off automatic switch (H-O-A) for fans shall override DDC start/stop (s/s). All hardwired safeties will be active in both hand and auto modes.
3. Autochangeover:

   a. Auto changeover refers to the ability of the system to automatically change between heating and cooling modes depending on the demand in each zone served. In a changeover system, the Tracer SC uses information from each zone to determine the heat/cool mode of the HVAC unit. The Tracer SC uses an algorithm to tally the votes from each zone for either heating or cooling. Based on the majority of votes, the HVAC unit is commanded to either heating or cooling.

4. Supply Duct Static Pressure Control:

   a. The unit controller will modulate the supply fan output as required to maintain the duct static pressure setpoint. If the duct static pressure falls below the supply air static setpoint + deadband, the unit controller will increase the output to the supply fan to maintain setpoint. If the duct static pressure rises above the supply air static setpoint + deadband, the unit controller will decrease the output to the supply fan to maintain setpoint.
   b. If for any reason the supply air pressure exceeds the fixed supply air pressure limit of 3.5 inches of W.C. the supply fan will shut down. The unit will be allowed to restart three times. If the overpressurization conditions occurs on the fourth restart, the unit will shut down and manual reset diagnostic is displayed at the remote panel and/or the BMS system.

B. Occupied Mode:

1. The unit will be optimally started and stopped by unit UCP as directed by the SC with time schedules or as directed by the system operator. Once the unit is

started, if all zones are at or above the occupied heating setpoint, the remote outdoor air damper will open to its preset and adjustable minimum position. If any zone is below the occupied heating setpoint the outdoor air damper will remain closed until that zone is at or above the occupied heating setpoint at which time the outdoor air damper will be allowed to open.

2. During occupied periods, the supply fan will run continuously and the outside air damper will open to maintain minimum ventilation requirements unless the demand ventilation or economizing sequences are active. The return damper will be inversely interlocked with the outdoor air damper. Each zone damper will modulate to maintain its respective zone air temperature. When not calling for heat or cool mode the damper shall be at its minimum 10% position.
3. The DX cooling will cycle on to maintain the current average space temperature compared to the average space temperature setpoint and the amount of heat or cool calls. If economizing is enabled the outside air damper will modulate to maintain the current average space temperature setpoint. When there are no cooling calls the cooling will be de-energized until a cooling call comes from the system. See Zone Heat/Cool Call strength section on this page.
4. Reheat Coil: During occupied periods, when the fan is running, a Multi-purpose controller, through Custom Programming Language (TGP2) & PID Loops, shall modulate the associated control valve to maintain the desired supply air temperature. Reheat coil is mounted downstream of RTU in duct. A duct temperature sensor located in the reheat coil discharge shall on sensing a reheat coil discharge temperature of 33°F or below, stop the fan, open the reheat coil valve fully and start the associated hot water circulating pump. The circulating pump will be off when a call for heat is not active. The associated hot water circulating pump shall run continuously when the outdoor air temperature falls below 35°F (Adjustable). When there are no heating calls the heating valve will close until a heating call comes from the system once again. A heating call takes priority over a cooling call. See Zone Heat/Cool Call strength section on this page. (Mote: access door provided on either side of heating coil shall aid in installation and commissioning of hot water coil).
5. When economizing is enabled and the unit is operating in the cooling mode if the outside air enthalpy rises above the return air enthalpy the economizer will be positioned to provide minimum outdoor airflow and the condensing unit staged to maintain room cooling setpoint temperature. The hot water coil discharge air temperature will alarm be alarmed if the temperature falls below 48°F during mechanical cooling.
6. If any space mounted CO_2 sensor senses a CO_2 level above 900 ppm, (Adjustable), the outdoor air damper will open 100%. Once the CO_2 level drops below the setpoint for 5 minutes, (Adjustable), the outdoor air damper will modulate to maintain the desired mixed air temperature.
7. The SC will poll the space sensors and compare the temperatures with the setpoint temperatures (Adjustable). If the majority of the space requires cooling and the outdoor air temperature is above the d/x cooling lockout setpoint, the unit UCP will enable the d/x cooling to start. The d/x cooling will remain “ON” until the

space sensors reach setpoint, at which time the unit UCP will cycle the d/x cooling to "OFF".

8. At this time the unit discharge temperature will be maintained at its setpoint by sequencing the direct expansion cooling coil and the duct mounted hot water coil valve as follows: on a rise in discharge temperature above setpoint the control system will energize the d/x cooling. Once the setpoint has been reached the d/x cooling will be disabled. On a drop in discharge temperature below setpoint, the outdoor air damper will return to its minimum position and the control system will modulate the hot water coil valve as required to again regain its setpoint.
9. At this time the finned tube radiation, convectors, and cabinet unit heaters will cycle open and closed to maintain space temperature setpoint through the DDC/VAV dampers. Cabinet unit heaters supply fans will cycle in coordination with associated water control valves. The discharge setpoint will be adjustable and will be 55°F when the outdoor air temperature is above 65° F. Between 55 & 65°F outside air temperature, the discharge air temperature will be allowed to float with no mechanical heating or cooling required unless the discharge air temperature floats outside the active minimum and maximum discharge limit temperatures. The direct expansion cooling will be automatically locked out at 61°F. (Adjustable). The operator may override the lockout if desired from the local Summit or remotely from the Summit located at all Head Ends.
10. The outdoor air damper will also modulate to maintain discharge setpoint for an economizer cycle. The controller will determine its required setpoint based on occupancy status, heat/cool zone requirements and their deviation from setpoint.

C. Heat/Cool Decision and Control of the RTU:

1. The controller programming determines the quantity and the strength of all heating and cooling calls. At power-up and on transition from unoccupied to occupied, the greater number of heat or cool calls determines the heat/cool mode and the RTU system. If the votes are tied, the system defaults to heat. If all the spaces are satisfied (No Call) the system will send a Fan Only request to the RTU.

D. Zone Heat/Cool Call Strength:

1. After the heat/cool mode of the zone is decided, the strength of its heating or cooling call is determined.

   a. Cool caller: A VAV becomes a "cool caller" if it is a voting VAV and its zone temperature is more than 1°F above the active cooling setpoint. A VAV loses its cool caller status if it becomes a non-voter or if its zone temperature is less than the active cooling setpoint plus 0.5°F.
   b. Strong cool caller: A VAV becomes a "strong cool caller" if it is a voting VAV and its zone temperature is more than 2°F above the active cooling setpoint. A VAV loses its strong cool caller status if it becomes a non-voter or if its zone temperature is less than the active cooling setpoint plus 1°F.
   c. Heat caller on a VAV with no local heat or Priority Local Heat edited to off: A VAV becomes a "heat caller" if it is a voting VAV and its zone

temperature is more than 1°F below the active heating setpoint. A VAV loses its heat caller status if it becomes a non-voter or if its zone temperature is greater than the active heating setpoint minus 0.5°F.

d. Strong heat caller on a VAV with no local heat or priority local heat edited to off: A VAV becomes a "strong heat caller" if it is a voting VAV and its zone temperature is more than 2°F below the active heating setpoint. A VAV loses its strong heat caller status if it becomes a non-voter or if its zone temperature is greater than the active heating setpoint minus 1°F.

e. Heat caller on a VAV with local heat and Priority Local Heat edited to on: A VAV becomes a heat caller if it is a voting VAV, its local heat has not been disabled by the Tracer SC, and its zone temperature is more than 2°F below the active heating setpoint. A VAV loses its heat caller status if it becomes a non-voter or if its zone temperature is greater than the active heating setpoint minus 1.5°F.

f. Strong heat caller on a VAV with local heat and Priority Local Heat edited to on: A VAV becomes a strong heat caller if it is a voting VAV, its local heat has not been disabled, and its zone temperature is more than 3°F below the active heating setpoint. A VAV loses its strong heat caller status if it becomes a non-voter or if its zone temperature is greater than the active heating setpoint minus 2°F.

E. Supply Fan Failure: If the supply fan fails as sensed by the supply fan current sensing relay, the control system shall energize an alarm light located in Office No. 102 (Clerks Room). An alarm will also be generated at the building control system that will automatically message selected workstations and pagers.

F. Dirty Filter: A filter differential pressure switch will alert the local operator of a dirty filter condition at the control system, it is not considered a critical alarm for message requirements.

G. Low Limit Detection: A low limit thermostat located in the discharge of the hot water coil will, on sensing a discharge temperature below its setpoint of 38ºF., will stop the fan, open the hydronic coil valve 100%, stop the fresh air fan and close the outside air damper. The control system will then message an alarm as stated above.

H. Low supply Air Temperature Alarm: If the discharge air temperature at the hot water coil falls below 48°F (adj.), an alarm will be sent to the workstation.

I. Smoke and Fire Control: Smoke detectors located where shown on the Plans shall, on sensing products of combustion, signal an alarm and stop the associated unit fans. All applicable installers (such as Fire Alarm System and BAS/ATC System) shall be on-site at the same time for connections to other building systems.

J. Preheat Coil: During occupied periods, when the fan is running, a Multi-purpose controller, UC600, through Custom Programming Language (CPL) & PID Loops, shall modulate the associated control valve to maintain the desired supply air temperature. The associated hot water circulating pump shall run continuously when the outdoor air

temperature falls below 35°F (Adjustable). A duct temperature sensor located in the preheat coil discharge shall on sensing a pre-heat coil discharge temperature of 33 deg. F. or below, stop the fan, open the pre-heat coil valve fully and start the associated hot water circulating pump.

K. Unoccupied Mode: During the unoccupied mode the air handler controller will cycle the unit on and off to maintain its unoccupied temperature setpoints. The outside air damper will remain closed. When the outdoor air temperatures drops below 30°F (adjustable) during the unoccupied mode the finned tube radiation and convectors will cycle open and closed to maintain unoccupied space temperature setpoints.

1. When the average space temperature is below the unoccupied heating setpoint of 60°F (adj.) the supply fan will operate, the outside air damper will remain closed, and the heating coil will be modulate to maintain a coil discharge air temperature of 90°F.
2. When the average space temperature rises above the unoccupied heating setpoint of 60°F (adj.) plus the unoccupied differential of 4°F (adj.) the supply fan will stop and the heating coil shall be disabled.
3. When the average space temperature is above the unoccupied cooling setpoint of 85°F (adj.) the supply fan will be enabled, the outside air damper will remain closed and DX cooling will be enabled if not economizing, if economizing the outside air damper will open and the DX will be disabled.
4. Zone dampers will be closed unless the system is put into night setback or override system mode.

L. Override: The system may be indexed from an unoccupied mode to a timed override (occupied) mode if the occupant pushes the timed override button only in Maintenance Clerk's Office or Repair Office. The system is also capable of canceling this override.

M. Morning Warm-Up Control:

1. If the space temperature is below 63°F, morning warm-up will be activated. When activated the outside air damper is closed, and hot water coil will modulate to maintain a hot water coil discharge air temperature of 90°F (adj.). When average room temperature rises above the occupied heating setpoint of 69°F (adj.) occupied mode will start.

N. RTU Points List:

1. Supply Fan Start/Stop.
2. Supply Fan Status, Current Sensing Relay.
3. Dirty Filter Switch.
4. Mixed Air Temperature.
5. Discharge Air Temperature.
6. Outside Air damper % Modulation.
7. Remote Alarm Light.
8. Hydronic Coil Low Limit Thermostat (Freezestat).

9. Hydronic Coil % Valve Modulation.
10. Duct static pressure.

1.6 TERMINAL UNIT OPERATING SEQUENCE (REPAIR):

A. Unit Heaters, Bay Areas, Wash Bays, Weld Shop, and Stock Room: Start the unit heater fans when the space temperature sensor drops below setpoint and stop the unit heater fans when the space temperature rises above setpoint. The unit heaters shall be locked out if the outdoor air temperature is above 60°F or hot water supply temperature is below 90°F (adjustable).

1. Setpoints (Adjustable):

a. Occupied: 55°F.
b. Unoccupied: 40°F.

2. When an overhead door is opened, the associated unit heater fans shall stop and shall not restart until the door is closed. All door open/close cycles shall be recorded in the Event Log.
3. Points List:

a. UH-1 Start/Stop.
b. UH-2 Start/Stop.
c. UH-4(A) Start/Stop.
d. UH-4(B) Start/Stop.
e. UH-4(C) Start/Stop.
f. UH-4(D) Start/Stop.
g. UH-4(E) Start/Stop.
h. UH-5(A) Start/Stop.
i. UH-5(B) Start/Stop.
j. UH-1 & ERV-1 Space Temperature.
k. UH-2 & ERV-2 Space Temperature.
l. UH-4(A) & ERV-4(A) Space Temperature.
m. UH-4(B) & ERV-4(B) Space Temperature.
n. UH-4(C) & ERV-4(C) Space Temperature.
o. UH-4(D) & ERV-4(D) Space Temperature.
p. UH-5(A) & ERV-5(A) Space Temperature.
q. Weld Shop Door B12.
r. Wash Bay Door B11.
s. Bay Doors B10 & B09.
t. Bay Doors B08 & B07.
u. Bay Door B06 & B05.
v. Bay Door B04 & B03.
w. Bay Doors B02.
x. Stock Room Door B01.

B. Unit Heaters, Mechanical Room, Electrical Room, Sprinkler Room, and Lubricant Storage/Compressor Room: Start the unit heater fans when the space temperature sensor drops below setpoint and stop the unit heater fans when the space temperature rises above setpoint. The unit heaters shall be locked out if the outdoor air temperature is above 60°F or hot water supply temperature is below 90°F (adjustable).

1. Setpoints (Adjustable):

   a. Occupied: 55°F.
   b. Unoccupied: 40°F.

2. Points List:

   a. UH-3 Start/Stop.
   b. UH-6 Start/Stop.
   c. UH-7 Start/Stop.
   d. EUH-1 Start/Stop.
   e. UH-3 & ERV-3 Start/Stop.
   f. UH-6 & ERV-8 Space Temperature.
   g. UH-7 & ERV-9 Space Temperature.
   h. EUH-1 & AF-1 Space Temperature.

C. Finned Tube Radiation, Convectors and Cabinet Unit Heaters:

1. Finned tube radiation and convectors that are not associated with the VAV air terminal units shall be provided with DDC hot water control valves and adjustable space sensors.

   a. Points List:

      1) C-1 Space Temperature.
      2) C-1 Start/Stop.

2. Monitor hot water return temperature from finned tube radiation, convectors, and cabinet unit heaters.

   a. Points List:

      1) R-1 Hot Water Return Temperature.
      2) R-2 Hot Water Return Temperature.
      3) R-3 Hot Water Return Temperature.
      4) R-4 Hot Water Return Temperature.
      5) R-5 Hot Water Return Temperature.
      6) C-1 Hot Water Return Temperature.
      7) C-2(A) Hot Water Return Temperature.
      8) C-2(B) Hot Water Return Temperature.
      9) C-3 Hot Water Return Temperature.
      10) C-4 Hot Water Return Temperature.

11) C-5(A) Hot Water Return Temperature.
12) C-5(B) Hot Water Return Temperature.
13) C-6 Hot Water Return Temperature.
14) CUH-1 Hot Water Return Temperature.
15) CUH-2 Hot Water Return Temperature.

D. Radiant Floor Heating, Repair Bays:

1. Associated control valve shall modulate open to maintain slab temperature setpoint of 70°F (adjustable). The associated circulating pump shall be locked out if the outdoor air temperature is above 60°F or hot water supply temperature is below 90°F (adjustable).

1.7 TERMINAL UNIT OPERATING SEQUENCE (MAINTENACE):

A. Unit Heaters, Bay Areas, and Wash Bays: Start the unit heater fans when the space temperature sensor drops below setpoint and stop the unit heater fans when the space temperature rises above setpoint. The unit heaters shall be locked out if the outdoor air temperature is above 60°F or hot water supply temperature is below 90°F (adjustable).

1. Setpoints (Adjustable):

a. Occupied: 55°F.
b. Unoccupied: 40°F.

2. When an overhead door is opened, the associated unit heater fans shall stop and shall not restart until the door is closed. All door open/close cycles shall be recorded in the Event Log.
3. Points List:

a. UH-3(A) Start/Stop.
b. UH-3(B) Start/Stop.
c. UH-3(C) Start/Stop.
d. UH-3(D) Start/Stop.
e. UH-3(E) Start/Stop.
f. UH-3(F) Start/Stop.
g. UH-3(G) Start/Stop.
h. UH-3(H) Start/Stop.
i. UH-4(A) Start/Stop.
j. UH-4(B) Start/Stop.
k. UH-5(A) Start/Stop.
l. UH-5(B) Start/Stop.
m. UH-3(A) & ERV-3(A) Space Temperature.
n. UH-3(C) & ERV-3(B) Space Temperature.
o. UH-3(E) & ERV-3(C) Space Temperature.
p. UH-4(G) & ERV-3(D) Space Temperature.

q. UH-4(B) & ERV-4 Space Temperature.
r. UH-5(A) & ERV-5 Space Temperature.
s. Bay Doors B01 & B02.
t. Bay Doors B03 & B04.
u. Bay Doors B05 & B06.
v. Bay Doors B07.
w. Bay Door B13 & B14.
x. Bay Door B11 & B12.
y. Bay Doors B09 & B10.
z. Bay Doors B08.
aa. Wash Bay Door B116A.
bb. Wash Bay Door B116B.
cc. Bay Door 117B.
dd. Bay Doors 117C & 117D.

B. Unit Heaters, Mechanical Room, Electrical Room, Sprinkler Room, and Bay Connector: Start the unit heater fans when the space temperature sensor drops below setpoint and stop the unit heater fans when the space temperature rises above setpoint. The unit heaters shall be locked out if the outdoor air temperature is above 60°F or hot water supply temperature is below 90°F (adjustable).

1. Setpoints (Adjustable):

a. Occupied: 55°F.
b. Unoccupied: 40°F.

2. Points List:

a. UH-1 Start/Stop.
b. UH-2(A) Start/Stop.
c. UH-2(B) Start/Stop
d. UH-6 Start/Stop
e. EUH-1 Start/Stop
f. UH-1 & ERV-1 Space Temperature.
g. UH-2(B) & ERV-2 Space Temperature.
h. UH-6 & ERV-8 Space Temperature.
i. EUH-1 & ERV-9 Space Temperature.

C. Finned Tube Radiation, Convectors and Cabinet Unit Heaters:

1. Finned tube radiation and convectors that are not associated with the VAV air terminal units shall be provided with DDC hot water control valves and adjustable space sensors.

a. Points List:

1) C-2 Space Temperature.

2) C-2 Start/Stop.

2. Monitor hot water return temperature from finned tube radiation, convectors, and cabinet unit heaters.

a. Points List:

1) R-1 Hot Water Return Temperature.
2) R-2 Hot Water Return Temperature.
3) R-3 Hot Water Return Temperature.
4) R-4 Hot Water Return Temperature.
5) R-5 Hot Water Return Temperature.
6) C-1(A) Hot Water Return Temperature.
7) C-1(B) Hot Water Return Temperature.
8) C-2 Hot Water Return Temperature.
9) CUH-1 Hot Water Return Temperature.
10) CUH-2 Hot Water Return Temperature.
11) CUH-3 Hot Water Return Temperature.

1.8 VENTILATION SEQUENCES (REPAIR):

A. All Bay Areas and Stock Room:

1. Start the associated exhaust fans when an overhead door is opened or closed and stop the exhaust fans after 5 minutes of run time; adjustable without requiring a programming change.
2. Start the associated exhaust fans when the room temperature exceeds its setpoint of 85°F (adjustable) and stop the exhaust fans when the temperature drops below setpoint.
3. Occupied period manual override for exhaust fan located in Wash Bays and Weld Shop:

a. Push-Button Operation: Start the associated exhaust fan(s) for 5 minute run time.

4. Points List:

a. ERV-1 Start/Stop/Status.
b. ERV-2 Start/Stop/Status.
c. ERV-4(A) Start/Stop/Status.
d. ERV-4(B) Start/Stop/Status.
e. ERV-4(C) Start/Stop/Status.
f. ERV-4(D) Start/Stop/Status.
g. ERV-5(A) Start/Stop/Status.
h. ERV-5(B) Start/Stop/Status.
i. ERV-1 Space Temperature.

j. ERV-2 Space Temperature.
k. ERV-4(A) Space Temperature.
l. ERV-4(B) Space Temperature.
m. ERV-4(C) Space Temperature.
n. ERV-4(D) Space Temperature.
o. ERV-5(A) Space Temperature.
p. ERV-5(B) Space Temperature.

B. Vehicle Exhaust System:

1. Start/stop the vehicle exhaust fans with the associated switches.
2. Enable in the occupied mode and disable in the unoccupied mode.
3. Points List:

a. VEF-1 Start/Stop/Status.
b. VEF-2 Start/Stop/Status.

C. Weld Shop:

1. Start/stop the welding exhaust fans with the associated switches.
2. Enable in the occupied mode and disable in the unoccupied mode.
3. Points List:

a. Welding Exhaust Fan 1 Start/Stop/Status.
b. Welding Exhaust Fan 2 Start/Stop/Status.

D. Mechanical Room: Start the exhaust fan when the space temperature exceeds its setpoint of 85°F (adjustable) and stop the exhaust fan when the temperature drops below setpoint.

1. Install the interlock to shutdown the exhaust fan when any Mechanical Room fire alarm detector activates. All applicable installers (such as Fire Alarm System, BAS/ATC System) shall be on-site at the same time for connections to other building systems.

2. Points List:

a. ERV-8 Start/Stop/Status.
b. Fire Alarm Detector

E. Electrical Room, Sprinkler Room, and Lubricant Storage/Compressor Room: Start the exhaust fan when the space temperature exceeds its setpoint of 85°F (adjustable) and stop the exhaust fan when the temperature drops below setpoint.

1. Points List:

a. AF-1 Start/Stop/Status.
b. ERV-9 Start/Stop/Status.

c. ERV-3 Start/Stop/Status.

F. Break Room, Kitchen hood:

1. Start/stop the supply and exhaust fans with the associated switch.
2. Enable in the occupied mode and disable in the unoccupied mode.
3. Points List:

a. SF-1 Start/Stop/Status.
b. EF-1 Start/Stop/Status.

G. Bathrooms, Lockers, Janitor's Closet: Enable in the occupied mode and disable in the unoccupied mode.

1. Points List:

a. ERV-6 Start/Stop/Status.
b. ERV-7 Start/Stop/Status.

H. Paddle Fans: Enable in the occupied mode and disable in the unoccupied mode.

1. Points List:

a. PF-1 Start/Stop/Status.
b. PF-2 Start/Stop/Status.
c. PF-3(A) Start/Stop/Status.
d. PF-3(B) Start/Stop/Status.
e. PF-3(C) Start/Stop/Status.
f. PF-3(D) Start/Stop/Status.
g. PF-3(E) Start/Stop/Status.
h. PF-3(F) Start/Stop/Status.
i. PF-4 Start/Stop/Status.

1.9 VENTILATION SEQUENCES (MAINTENACE):

A. Bay Areas:

1. Start the associated exhaust fans when an overhead door is opened or closed and stop the exhaust fans after 5 minutes of run time; adjustable without requiring a programming change.
2. Start the associated exhaust fans when the room temperature exceeds its setpoint of 85°F (adjustable) and stop the exhaust fans when the temperature drops below setpoint.
3. Occupied period manual override for exhaust fan located in Wash Bays.

a. Push-Button Operation: Start the associated exhaust fan(s) for 5 minute run time.

4. Points List:

    a. ERV-3(A) Start/Stop/Status.
    b. ERV-3(B) Start/Stop/Status.
    c. ERV-3(C) Start/Stop/Status.
    d. ERV-3(D) Start/Stop/Status.
    e. ERV-4 Start/Stop/Status.
    f. ERV-5 Start/Stop/Status.
    g. ERV-3(A) Space Temperature.
    h. ERV-3(B) Space Temperature.
    i. ERV-3(C) Space Temperature.
    j. ERV-3(D) Space Temperature.
    k. ERV-4 Space Temperature.
    l. ERV-5 Space Temperature.

B. Mechanical Room: Start the exhaust fan when the space temperature exceeds its setpoint of 85°F (adjustable) and stop the exhaust fan when the temperature drops below setpoint.

1. Install the interlock to shutdown the exhaust fan when any Mechanical Room fire alarm detector activates. All applicable installers (such as Fire Alarm System, BAS/ATC System) shall be on-site at the same time for connections to other building systems.

2. Points List:

    a. ERV-8 Start/Stop/Status.
    b. Fire Alarm Detector

C. Electrical Room, Sprinkler Room, and Bay Connector: Start the exhaust fan when the space temperature exceeds its setpoint of 85°F (adjustable) and stop the exhaust fan when the temperature drops below setpoint.

1. Points List:

    a. ERV-1 Start/Stop/Status.
    b. ERV-2 Start/Stop/Status.
    c. ERV-9 Start/Stop/Status.

D. Bathrooms, Lockers, Janitor's Closet: Enable in the occupied mode and disable in the unoccupied mode.

1. Points List:

    a. ERV-6 Start/Stop/Status.
    b. ERV-7 Start/Stop/Status.

E. Paddle Fans: Enable in the occupied mode and disable in the unoccupied mode.

1. Points List:

a. PF-1 Start/Stop/Status.
b. PF-2(A) Start/Stop/Status.
c. PF-2(B) Start/Stop/Status.
d. PF-2(C) Start/Stop/Status.
e. PF-2(D) Start/Stop/Status.
f. PF-3(A) Start/Stop/Status.
g. PF-3(B) Start/Stop/Status.
h. PF-4 Start/Stop/Status.

1.10 MISCELLANEOUS EQUIPMENT SEQUENCES:

A. Emergency Generator Exerciser: The SC shall provide programmed start/stop of the emergency generator and transfer switch for a period of 30 minutes under load on a weekly basis. If the emergency generator fails to start as programmed; an alarm shall be generated at the SC, which shall message selected pagers. The SC shall show the cumulative run-time on the emergency generator.

1. Points List:

a. Generator Enable/Disable.
b. Generator Status for Run-time.

B. Air Compressor: Enable the air compressor in the occupied mode and disable the air compressor in the unoccupied mode. The SC shall show the cumulative run-time on the air compressor.

1. Points List:

a. Air Compressor Enable/Disable.
b. Air Compressor Status for Run-time.

C. Domestic Hot Water Re-circulation Pump: Enable the pump in the occupied mode and disable the pump in the unoccupied mode. In the occupied mode, the SC shall stop the pump when the water temperature reaches 120°F and shall start the pump when the water temperature reaches 100°F. The SC shall monitor the hot water return temperature. The SC shall show the cumulative run-time on the pumps.

1. Points List:

a. Pump Enable/Disable.
b. Pump Status for Run-time.

D. Water Heater: Enable in the occupied mode and disable in the unoccupied mode. Once enabled, the water heater shall operate on its own self-contained controls until the water temperature achieves the desired temperature.

1. Points List:

a. Water Heater Enable/Disable/Status.
b. Domestic Hot Water Temperature.

E. Block Heaters: Enable the block heaters when the outdoor air temperature is below 40°F and disable when the outdoor air temperature is 40°F and above.

1. Points List:

a. Block Heater Enable/Disable/Status.

F. Exterior Lighting: Turn on exterior lighting at sunset and turn off at sunrise. Sunrise and sunset times shall be based on facility location coordinates and shall have a programmable time delay to compensate for the last few minutes of sunrise and first few minutes of sunset. If the exterior lighting is manually overridden by the 2-position auto/override switch (as shown on the Electrical Plans), an alarm will be generated at the SC.

1. Points List:

a. Exterior Lighting On/Off/Status.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.

1.2 PERFORMANCE REQUIREMENTS:

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.

B. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of the following:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
5. Pressure regulators. Indicate pressure ratings and capacities.
6. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Delegated-Design Submittal: For natural-gas piping and equipment 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. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

1.4 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Qualification Data: For qualified professional engineer.
2. Welding certificates.
3. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For pressure regulators to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE:

A. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.8 COORDINATION:

A. Coordinate natural-gas connections to components furnished by utility companies.

B. Natural-Gas Service: Natural-gas service to the building as well as the meter set shall be furnished and installed by Eversource. There is an estimated Eversource utility charge of $175,000 for their work which should be included in the contract bid price. This amount also includes the service connections to the facility by the utility company. All Contractors will include the above amount for utility service charges in the Contract Bid Price. If it is determined that different charges apply, the Contractor's bid will be adjusted to reflect the differential by construction order, provided that the Contractor provides all applicable written billing documentation. The contractor will be compensated only for the difference between the billed amount and the estimated amount. No additional Contractor markup will be allowed. All bidders will include the utility charge in Item No. 170001A – Service Connections (Estimated Cost) along with costs for work by other utilities.

1. The Contractor shall coordinate the scheduling of work to be performed by Eversource. The contractor is advised that Eversource requires a minimum of 6 months to complete its design work before they can commence their construction activities. This time period commences with their receipt of the utility charge.

2. The utility charge shall be sent with a note referencing this project by project number and the street address (3 Industrial Park Road, Putnam, CT) to:

   Jack Cannone
   Eversource
   112 Prospect Hill Road
   East Windsor, CT 06088

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS:

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

   a. Material Group: 1.1.
   b. End Connections: Threaded or butt welding to match pipe.
   c. Lapped Face: Not permitted underground.
   d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
   e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

2.2 PIPING SPECIALTIES:

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Corrugated stainless-steel tubing with polymer coating.
3. Operating-Pressure Rating: 0.5 psig.
4. End Fittings: Zinc-coated steel.
5. Threaded Ends: Comply with ASME B1.20.1.

6. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded.
3. Strainer Screen: 40 or 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS:

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MANUAL GAS SHUTOFF VALVES:

A. See "Aboveground Manual Gas Shutoff Valve Schedule" for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
5. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. BrassCraft Manufacturing Company; a Masco company.
    b. Conbraco Industries, Inc.; Apollo Div.
    c. Lyall, R. W. & Company, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded as indicated in "Aboveground Manual Gas Shutoff Valve Schedule."
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Homestead Valve.
    b. A.Y. McDonald Mfg. Co.
    c. Lee Brass Company.

2. Body: Bronze, complying with ASTM B584.
3. Plug: Bronze.
4. Ends: Flanged as indicated in "Aboveground Manual Gas Shutoff Valve Schedule."
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 PRESSURE REGULATORS:

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Actaris.
   b. American Meter Company.
   c. Eclipse Combustion, Inc.
   d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   e. Invensys.
   f. Maxitrol Company.
   g. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Canadian Meter Company Inc.

b. Eaton Corporation; Controls Div.
c. Harper Wyman Co.
d. Maxitrol Company.
e. SCP, Inc.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 OUTDOOR PIPING INSTALLATION:

A. Comply with NFPA 54 and the Connecticut Gas Equipment and Piping Code for installation and purging of natural-gas piping.

B. Install fittings for changes in direction and branch connections.

C. Install sleeves and sleeve seals for piping penetrations of exterior walls. Comply with requirements for sleeve seals specified in Division 23 Section 230517, "Sleeves and Sleeve Seals for HVAC Piping."

3.3 INDOOR PIPING INSTALLATION:

A. Comply with NFPA 54 and the Connecticut Gas Equipment and Piping Code for installation and purging of natural-gas piping.

B. Plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Locate valves for easy access.

G. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in CSI Division 07 Section 078413, "Penetration Firestopping."

K. Verify final equipment locations for roughing-in.

L. Install appliance regulators on inlet piping to each natural gas fired equipment burner.

M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

N. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

    1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

O. Extend relief vent connections for line regulators and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

P. Prohibited Locations:

    1. Do not install natural-gas piping in or through circulating air ducts, chimneys or gas vents (flues), or ventilating ducts.
    2. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator.

V. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in CSI Division 23 Section 230519 "Meters and Gages for HVAC Piping."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in CSI Division 23 Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in CSI Division 23 Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

3.4 VALVE INSTALLATION:

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.5 PIPING JOINT CONSTRUCTION:

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.6 HANGER AND SUPPORT INSTALLATION:

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in CSI Division 23 Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for pipe hangers and supports specified in CSI Division 23 Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.

3.7 CONNECTIONS:

A. Install piping adjacent to appliances to allow service and maintenance of appliances.

B. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

C. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.8 LABELING AND IDENTIFYING:

A. Comply with requirements in CSI Division 23 Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.9 PAINTING:

A. Comply with requirements in CSI Division 09 Painting Sections for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Color: Yellow.

C. Paint exposed, interior metal piping, valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Color: Yellow.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 FIELD QUALITY CONTROL:

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and the Connecticut Gas Equipment and Piping Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 OUTDOOR PIPING SCHEDULE:

A. Aboveground natural-gas piping shall be one of the following:

1. NPS 2 and Smaller: Steel pipe with malleable-iron fittings and threaded joints.
2. NPS 2-1/2 and Larger: Steel pipe with wrought-steel fittings and welded joints.

3.12 INDOOR PIPING SCHEDULE:

A. Aboveground, natural-gas piping shall be one of the following:

1. NPS 2 and Smaller: Steel pipe with malleable-iron fittings and threaded joints.
2. NPS 2-1/2 and Larger: Steel pipe with wrought-steel fittings and welded joints.

3.13 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE:

A. Aboveground, natural-gas shutoff valves shall be one of the following:

1. NPS 2 and Smaller: Two-piece, full-port, bronze ball valves with threaded ends and bronze trim.
2. NPS 2-1/2 and Larger: Lubricated bronze plug valve with flanged ends.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes pipe and fitting materials and joining methods for the following:

1. Hot-water heating piping.
2. Makeup-water piping.
3. Condensate-drain piping.
4. Blowdown-drain piping.
5. Air-vent piping.
6. Safety-valve-inlet and -outlet piping.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of the following:

1. Piping, fittings, and joining materials.
2. Dielectric fittings.
3. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Welding certificates.
3. Field quality-control reports.

1.4 QUALITY ASSURANCE:

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 125 psig at 200 deg F.
2. Makeup-Water Piping: 80 psig at 150 deg F.
3. Condensate-Drain Piping: 150 deg F.
4. Blowdown-Drain Piping: 200 deg F.
5. Air-Vent Piping: 200 deg F.
6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS:

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. Wrought-Copper Fittings: ASME B16.22.

1. Basis-of-Design Product: Subject to compliance with requirements, provide fittings by Victaulic Company or an approved equal.

D. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS:

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in Part 3.1"Piping Applications."

B. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

C. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

D. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 PLASTIC PIPE AND FITTINGS:

A. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in Part 3.1 "Piping Applications."

1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe.

2.5 JOINING MATERIALS:

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

a. PVC solvent cement shall have a VOC content of 510 g/L or less.
b. Adhesive primer shall have a VOC content of 550 g/L or less.

F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.6 DIELECTRIC FITTINGS:

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Watts Regulator Co.

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 250 psig.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Watts Regulator Co.

2. Description:

a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: 150 psig.
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Calpico, Inc.
b. Central Plastics Company.

2. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Elster Perfection.
b. Precision Plumbing Products, Inc.
c. Victaulic Company.

2. Description:

a. Standard: IAPMO PS 66.
b. Electroplated steel nipple, complying with ASTM F 1545.
c. Pressure Rating: 300 psig at 225 deg F.
d. End Connections: Male threaded or grooved.
e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS:

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Makeup-water piping installed aboveground shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

D. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

E. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

F. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

G. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS:

A. Plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved by the Designer.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping tight to slabs, beams, joists, columns, walls, and other building elements.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

M. Install drains, consisting of a tee fitting, and ball-type hose end drain valve at low points in piping system mains and elsewhere as required for system drainage.

N. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

O. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

P. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

Q. Install valves according to CSI Division 23 Section 230523 "General-Duty Valves for HVAC Piping."

R. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

S. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

T. Install shutoff valve immediately upstream of each dielectric fitting.

U. Comply with requirements in CSI Division 23 Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

V. Comply with requirements in CSI Division 23 Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in CSI Division 23 Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION:

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.

C. Dielectric Fittings for NPS 2-1/2 and larger: Use dielectric flanges, flange kits, or nipples.

3.4 HANGERS AND SUPPORTS:

A. Comply with requirements in CSI Division 23 Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in CSI Division 23 Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 2-1/2: Maximum span, 11 feet.
2. NPS 3 and Larger: Maximum span, 12 feet.

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.

F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION:

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.6 TERMINAL EQUIPMENT CONNECTIONS:

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in CSI Division 23 Section 230519 "Meters and Gages for HVAC Piping."

3.7 FIELD QUALITY CONTROL:

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
3. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
4. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure or a minimum of 100 psi. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232116 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes special-duty valves and specialties for the following:

1. Hot-water heating piping.
2. Makeup-water piping.
3. Condensate-drain piping.
4. Blowdown-drain piping.
5. Air-vent piping.
6. Safety-valve-inlet and -outlet piping.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of the following:

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air-control devices.
3. Hydronic specialties.

1.3 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in the operation, and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE:

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 125 psig at 200 deg F.
2. Makeup-Water Piping: 80 psig at 150 deg F.
3. Condensate-Drain Piping: 150 deg F.
4. Blowdown-Drain Piping: 200 deg F.
5. Air-Vent Piping: 200 deg F.
6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES:

A. Check, Ball, and Butterfly Valves: Comply with requirements specified in CSI Division 23 Section 230523 "General-Duty Valves for HVAC Piping.

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in CSI Division 23 Section 230900 "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Bell & Gossett Domestic Pump.
b. Taco.

2. Body: Bronze or brass, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Removable lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Bell & Gossett Domestic Pump.
    b. Taco.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE or bronze.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

E. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. AMTROL, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett Domestic Pump.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: Removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. AMTROL, Inc.
    b. Armstrong Pumps, Inc.

c. Bell & Gossett Domestic Pump.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: Removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.3 AIR-CONTROL DEVICES:

A. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AMTROL, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett Domestic Pump.
d. Taco, Inc.

2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/4.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 240 deg F.

B. Bladder-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]

   a. AMTROL, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump.
   d. Taco, Inc.

2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Tank Volume: 132 (full acceptance).
4. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
5. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

C. Air Separators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AMTROL, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump.
   d. Taco, Inc.

2. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
3. Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
4. Blowdown Connection: Threaded.
5. Size: Match system flow capacity.

2.4 HYDRONIC PIPING SPECIALTIES:

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.

3. Strainer Screen: Stainless-steel, 40 or 60-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig.

B. Expansion Fittings: Comply with requirements in CSI Division 23 Section 230516 "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS:

A. Install shutoff-duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and at connection to automatic air vents.

B. Install throttling-duty valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe drain as indicated on the Plans. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION:

A. Install automatic air vents with ball valve at high points of system piping, at heat-transfer coils, in air separators, and elsewhere as required for air venting.

B. Install piping from boiler air outlet and air separator to expansion tank with a 2 percent upward slope toward tank.

C. Install air separators in pump suction. Install drain valve on air separators.

D. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 232116

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.
2. Separately coupled, horizontally mounted, in-line centrifugal pumps.

B. Related CSI Section:

1. Division 22 Section 221123, “Domestic Water Pumps.”

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of pump. Include standard wiring diagrams, certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For pumps to include in the operation, and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE:

A. Source Limitations: Obtain hydronic pumps and domestic water pumps through one source from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Refer to Form 818 Article 1.06.03 and Form 818 Article 1.20-1.06-.03 for additional information.

B. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

C. Store pumps in dry location.

D. Retain protective covers for flanges and protective coatings during storage.

E. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

F. Comply with pump manufacturer's written rigging instructions.

1.6 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal for each pump.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. TACO Incorporated.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

C. Pump Construction: Single-stage, bronze fitted.

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange connections.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, single suction, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: Single speed and rigidly mounted to pump casing. Include lifting and supporting lugs in top of motor enclosure.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Motors ½-HP and Larger: Three phase with built-in thermal-overload protection.
3. Motors Smaller than ½-HP: Single phase.

2.2 SEPARATELY COUPLED, HORIZONTALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. TACO Incorporated.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

C. Pump Construction: Single-stage, bronze fitted.

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, drain plug at low point of volute, and threaded companion-flange connections.
2. Impeller: ASTM B 584, cast bronze or noryl; statically and dynamically balanced, single suction, and keyed to shaft. For pumps not frequency-drive controlled, trim impeller to match specified performance.
3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings.

D. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment. One-piece spring-type coupling. Couplings with multiple springs shall not be permitted.

E. Motor: Single speed, double-shielded, pre-lubricated ball bearings, suitable for radial and thrust loading, and rigidly mounted to pump casing. Include lifting and supporting lugs in top of motor enclosure.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Motors ½-HP and Larger: Three phase with built-in thermal-overload protection.
3. Motors Smaller than ½-HP: Single phase.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION:

A. Comply with HI 1.4.

B. Install pumps according to manufacturer's written instructions and with access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Unless otherwise required by manufacturer's written instructions, independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Unless otherwise required by manufacturer's written instructions, install in-line pumps with continuous-thread hanger rods and elastomeric hangers, spring hangers, or spring hangers with vertical-limit stop of size required to support weight of in-line pumps.

1. Comply with requirements for seismic-restraint devices specified in CSI Division 23 Section 230548 "Vibration and Seismic Controls for HVAC."
2. Comply with requirements for hangers and supports specified in CSI Division 23 Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
3. Install seismic bracing as required by authorities having jurisdiction.

3.3 ALIGNMENT:

A. Perform alignment service.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS:

A. Comply with requirements for piping specified in CSI Division 23 Sections. Plans indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install balancing valves on discharge side of pumps. Comply with requirements specified in CSI Division 23 Section 232116 “Hydronic Piping Specialties.”

F. Install shutoff valves on discharge side of pumps. Comply with requirements specified in CSI Division 23 Section 230523 “General-Duty Valves for HVAC Piping.”

G. Install Y-type strainer and shutoff valve on suction side of pumps.

H. Install pressure gages on pump suction and discharge.

I. Current switches for pump control, control wiring, and connections for the BAS/ATC System are specified in CSI Division 23 Section 230900 “Instrumentation for Control for HVAC.” The BAS/ATC Installer shall perform this work.

J. Ground equipment according to CSI Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to CSI Division 26 Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE:

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

   a. Verify bearing lubrication.
   b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
   c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.6 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Seismic-restraint devices.

B. Related CSI Sections:

1. Division 23 Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS:

A. Static-Pressure Classes:

1. Supply Ducts: 2-inch wg.
2. Return Ducts (Negative Pressure): 2-inch wg.
3. Exhaust Ducts (Negative Pressure): 2-inch wg.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of the following products:

1. Sheet metal materials.
2. Sealants and gaskets.

3. Hangers and Supports.
4. Seismic-restraint devices.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS:

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS:

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS:

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS:

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS:

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Rectangular Duct Hangers Minimum Size" table and, "Minimum Hanger Sizes for Round Duct" table.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.6 SEISMIC-RESTRAINT DEVICES:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Loos & Co.; Cableware Division.
6. Mason Industries.
7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of the ICC Evaluation Service or an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections, or reinforcing steel angle clamped to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

1. Takeoff fittings shall not be installed in the top of supply air ducts.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in CSI Division 23 Section 233300, "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in Part 3.9 "Duct Schedule" according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Hangers and Supports" chapter.

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Rectangular Duct Hangers Minimum Size," table and "Minimum Hanger Sizes for Round Duct" table for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an evaluation service member of the ICC Evaluation Service or an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with CSI Division 23 Section 233300, "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 FIELD QUALITY CONTROL

A. Visually (and audibly) inspect all seams and joints for leaks. Remake leaking joints and retest.

B. Visually inspect duct system to ensure that no visible contaminants are present.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 DUCT CLEANING:

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts or duct accessories.
4. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
5. Provide drainage and cleanup for wash-down procedures.
6. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.8 START UP

A. Air Balance: Comply with requirements in CSI Division 23 Section 230593, "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE:

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Moist Environment (Bathrooms, Locker Rooms and Janitor’s Closet) Exhaust Air Ducts: Aluminum.

B. Supply Ducts:

1. Pressure Class: Positive 2-inch wg.

C. Return Ducts:

1. Pressure Class: Positive or negative 2-inch wg.

D. Exhaust Ducts:

1. Pressure Class: Negative 2-inch wg.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Rectangular Elbows" figure.

   a. Velocity 1000 fpm or Lower:

      1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      2) Mitered Type RE 4 without vanes.

   b. Velocity 1000 to 1500 fpm:

      1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Vanes and Vane Runners" figure, and "Vane Support in Elbows" figure.

   c. Velocity 1500 fpm or Higher:

      1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Vanes and Vane Runners" figure, and "Vane Support in Elbows" figure.

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Round Duct Elbows" figure.

   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Mitered Elbows" figure. Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Branch Connection" figure.

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "90 Degree Tees and Laterals" figure, and "Conical Tees" figure. Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes air duct accessories.

B. Related Requirements:

1. Division 23 Section 230900, “Instrumentation and Control for HVAC” for variable air volume terminal units and electric damper actuators.
2. Division 28 Section 283111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.4 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION:

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS:

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: **G90**.
2. Exposed-Surface Finish: Mill phosphatized.

B. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum ducts.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 MANUAL VOLUME DAMPERS:

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Greenheck Fan Corporation.
b. McGill AirFlow LLC.
c. Ruskin Company.

2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Blades:

a. Single blade.
b. Stiffen damper blades for stability.

5. Blade Axles: Galvanized steel.
6. Bearings:

a. Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve.
b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Greenheck Fan Corporation.
   b. McGill AirFlow LLC.
   c. Ruskin Company.

2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Blades:

   a. Single blade.
   b. Stiffen damper blades for stability.

5. Blade Axles: Galvanized steel.
6. Bearings:

   a. Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

C. Jackshaft:

1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Greenheck Fan Corporation.
2. Ruskin Company.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: Static; rated and labeled according to UL 555 by an NRTL.

C. Fire Rating: 1-1/2 hours.

D. Frame: Curtain type with blades inside airstream or curtain type with blades outside airstream as detailed on the Plans; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.05 inch thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.024-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.5 TURNING VANES:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

2.6 DUCT-MOUNTED ACCESS DOORS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Flexmaster U.S.A., Inc.
3. Greenheck Fan Corporation.
4. McGill AirFlow LLC.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; "Duct Access Doors and Panels" figure, and "Access Doors - Round Duct" figure.

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
d. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.

4. Factory set at 10-inch wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE CONNECTORS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 4-3/8-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

2.8 FLEXIBLE DUCTS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.

3. Temperature Range: Minus 10 to plus 160 deg F.

C. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.

D. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.9 DUCT ACCESSORY HARDWARE:

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and aluminum accessories in aluminum ducts.

C. Install volume dampers where shown on the Plans and at points on supply, return, and exhaust systems where branches extend from larger ducts. Install at a minimum of two duct widths from the branch takeoff.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install fire dampers according to UL listing and manufacturer’s written instructions.

G. The HVAC Installer shall install duct smoke detectors in locations shown on the Plans. The Electrical Installer shall provide the duct smoke detectors, as specified in CSI Division 28 Section 283111, “Digital, Addressable Fire-Alarm System.”

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Downstream from manual volume dampers, control dampers, turning vanes, and equipment.
3. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
4. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access:

   a. Rectangular Ducts: 8 by 5 inches.
   b. Round Ducts: 8 inches.

2. Two-Hand Access:

   a. Rectangular Ducts: 12 by 6 inches.
   b. Round Ducts: 10 inches.

3. Head and Hand Access:

   a. Rectangular Ducts: 18 by 10 inches.
   b. Round Ducts: 12 inches.

K. Label access doors according to CSI Division 23 Section 230553, "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

N. Connect diffusers, registers, and grilles to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place. For moist environment ducts, connect diffusers, registers, and grilles directly.

O. Connect flexible ducts to metal ducts with draw bands.

P. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL:

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Centrifugal roof ventilators.
2. Paddle fans.

1.2 PERFORMANCE REQUIREMENTS:

A. Operating Limits: Classify according to AMCA 99.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.
8. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For power ventilators to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

1.7 QUALITY ASSURANCE:

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standards: Power ventilators shall comply with UL 705.

1.8 DELIVERY, STORAGE, AND HANDLING:

A. Deliver fans as a factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.9 COORDINATION:

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acme Engineering & Manufacturing Corporation.
2. Greenheck Fan Corporation.
3. Loren Cook Company.

B. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Fan and motor isolated from exhaust airstream.

F. Accessories:

1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.

G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Built-in cant and mounting flange.
2. Overall Height: 12 inches.

2.2 PADDLE FANS:

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the Plans as manufactured by Leading Edge, Inc., or and approved equal.

B. Description: Direct-driven paddle fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly, and accessories.

C. Housing: Galvanized steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.

D. Fan Wheel: Manufacturer's standard.

E. Motors: Direct-driven, permanent split-capacitor type, with permanently sealed ball bearings and thermal-overload protection.

F. Accessories:

1. Solid state motor speed controllers supplied by paddle fan manufacturer.

2.3 SOURCE QUALITY CONTROL:

A. Comply with sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Comply with fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Set roof curbs so top surface of equipment support is level in accordance with manufacturer's written installation instructions.

B. Install power ventilators level and plumb.

C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.

D. Support suspended units from structure using threaded steel rods and elastomeric hangers, spring hangers, or spring hangers with vertical-limit stops. Vibration-control devices are specified in CSI Division 23 Section 230548 "Vibration and Seismic Controls for HVAC."

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in CSI Division 23 Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS:

A. Duct installation and connection requirements are specified in other CSI Division 23 Sections. Plans indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in CSI Division 23 Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to CSI Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to CSI Division 26 Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

E. BAS/ATC control wiring and interlock wiring are specified in CSI Division 23 Section 230900 “Instrumentation and Control for HVAC.”

3.3 FIELD QUALITY CONTROL:

A. Engage a factory authorized service representative to perform the following field tests and inspections and prepare test reports.

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING:

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in CSI Division 23 Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

3.5 TRAINING:

A. Refer to From 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative to train the Owner’s maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Linear slot diffusers.
3. Fixed face grilles.

B. Related CSI Sections:

1. Division 08 Section 089000 “Louvers and Vents” for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section 233300 "Air Duct Accessories" for fire dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACOR – SUBMITTALS.

B. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.3 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS:

A. Rectangular and Square Ceiling Diffusers (D):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anemostat Products; a Mestek company.
   b. Carnes.
   c. Titus, Model No. TDC-AG-95-AA.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, white.
5. Face Size: As indicated on the Plans.
6. Face Style: Four cone minimum.
7. Mounting: T-bar.
8. Pattern: Fixed (FX), 2 way (2-W), or 4 way (4-W), as indicated on the Plans.
9. Dampers: Radial opposed blade.
10. Accessories:

   a. Equalizing grid.
   b. Plaster ring.
   c. Sectorizing baffles.

2.2 GRILLES:

A. Fixed Face Grille (RG):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anemostat Products; a Mestek company.
   b. Carnes.
   c. Titus, Model No. 50F.

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.
5. Core Construction: Integral.
6. Frame: 1-1/4 inches wide.
7. Mounting: Lay in.

2.3 SOURCE QUALITY CONTROL:

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions and referenced standards.

B. Ceiling-Mounted Outlets and Inlets: Plans indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Engineer for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING:

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233813 - COMMERCIAL-KITCHEN HOODS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes Type II commercial-kitchen hoods.

B. Related CSI Sections:

1. Division 23 Section 233423, "HVAC Power Ventilators."

1.2 DEFINITIONS:

A. Type II Hood: A hood designed for heat and steam removal and for other nongrease applications.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following:

1. Type II hoods.

1.4 INFORMATIONAL SUBMITTALS:

A. Welding certificates.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE:

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D 1.1M, "Structural Welding Code - Steel," for hangers and supports; and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for joint and seam welding.

PART 2 - PRODUCTS

2.1 HOOD MATERIALS:

A. Stainless-Steel Sheet: ASTM A 666, Type 304.

1. Minimum Thickness: 0.050 inch.

B. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial-kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR 177.2600, for use in areas that come in contact with food.

2.2 GENERAL HOOD FABRICATION REQUIREMENTS:

A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.

1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.

B. For metal butt joints, comply with SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."

C. Where stainless steel is joined to a dissimilar metal, use stainless-steel welding material or fastening devices.

D. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.

E. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.

F. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.

G. Fabricate seismic restraints according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," Appendix A, "Seismic Restraint Details."

H. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."

I. Fabricate enclosure panels to ceiling and wall as follows:

1. Fabricate panels on all exposed side(s) with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.

2.3 TYPE II EXHAUST HOOD FABRICATION:

A. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. GO exhaust hood with Model No. AC external air curtain supply plenum as manufactured by Greenheck Fan Corporation or an approved equal.

B. Fabricate hoods according to NSF 2, "Food Equipment."

C. Fabricate hoods to comply with SMACNA's "HVAC Duct Construction Standards: Metal and Flexible."

D. Hood Configuration: Exhaust and makeup air.

1. Makeup air shall be introduced through external supply plenum at front of hood, in a downward pattern, not containing any contaminated air.

E. Hood Type: Heat and vapor removal.

F. Hood Style: Wall-mounted canopy.

G. Capacities and Characteristics:

1. Nominal Hood Length: 42 inches.
2. Nominal Hood Width: 36 inches.
3. Exhaust Airflow: 600 cfm.
4. Exhaust-Air Pressure Loss: 0.5 inches wg.
5. Makeup Air Airflow: 600 cfm.
6. Makeup Air Pressure Loss: 0.5 inches wg.

H. Accessories:

1. Mesh Filter.
2. Factory-Mounted Exhaust Collar.
3. Remote Switch.
4. Ceiling Enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Coordinate equipment layout and installation with adjacent Work, including lighting fixtures, HVAC equipment, plumbing, and fire-suppression system components.

B. Complete field assembly of hoods where required.

1. Make closed butt and contact joints that do not require filler.

C. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods according to manufacturer's written instructions and requirements of authorities having jurisdiction.

D. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners unless otherwise indicated.

E. Install hoods to operate free from vibration.

F. Install seismic restraints according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," Appendix A, "Seismic Restraint Details."

G. Install items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches o.c. maximum.

H. Install sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.

I. Set field-adjustable switches.

3.3 CONNECTIONS:

A. Connect ducts according to requirements in CSI Division 23 Section 233300 "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquid tight joint.

3.4 OPERATION:

A. Exhaust and supply fans will run simultaneously and be operated by wall mounted switch as indicated on the Plans.

3.5 FIELD QUALITY CONTROL:

A. Perform the following tests and inspections:

1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Perform hood performance tests required by authorities having jurisdiction.

B. Commercial-kitchen hoods will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 233813

SECTION 233823 – INDUSTRIAL VENTILATING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Fume Exhaust System (Welding).
2. Mobile Filtration Unit (Welding).
3. Vehicle Exhaust Removal System.
4. Central Vacuum

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following as applicable:

1. Motor ratings and electrical characteristics, motor and electrical accessories, and wiring diagrams.
2. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: Include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE:

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

PART 2 - PRODUCTS

2.1 FUME EXHAUST SYSTEM:

A. Subject to compliance with requirements, the complete and fully-functional exhaust system shall be SnorkVac as manufactured by Enviroflex, or an approved equal.

B. Fume Extractor Arm: Wall-mounted, maximum nominal reach of 10-feet, with the following features.

1. 360° swivel elbow, of which approximately 180° will be available in this application.
2. Support flange.
3. Internal support structure.
4. Pre-set joints with wear disks.
5. Flame-retardant fiberglass reinforced flexible hose, 6-inch diameter.
6. Oval, or round with air diverter, polycarbonate-capture hood with damper, handle, work light, and control switch.

C. Provide Fume Extractor Arm/Fan Mounting Bracket.

D. Fan and Work Light Control Box: Manual start/stop control, with integral transformer for spotlight.

E. Work Light: Halogen, 35-W minimum with integral reflector, complete with lens, cable, and switch.

F. Exhaust Fan: Manufacturer's standard, as specified on the plans.

G. Exhaust Pipe: Manufacturer's standard, as specified on the plans.

2.2 MOBILE FILTRATION UNIT:

A. Mobile Filtration Unit: Self-contained mobile filtration unit with high separation capabilities for welding fumes, Enviromac as manufactured by Enviroflex., or an approved equal. Quantity one (1) for this project.

1. Fume Extractor Arm: Minimum 6-inch diameter, 7-foot long flame-retardant fiberglass reinforced flexible hose, with adjustable damper, 360° swivel elbow, oval, or round with air diverter, polycarbonate capture hood, and 20W minimum halogen light.
2. Exhaust Fan: Manufacturer's standard, with built-in motor protection.

a. Minimum Capacity: 588 CFM.
b. Motor: 1 HP, 115 V, 1 phase, 60 Hz.
c. Maximum Noise Level: 75.5 db(A) measured according to ISO EN 11204.

3. Filter: Cellulose, capable of 98% collection efficiency.

2.3 VEHICLE EXHAUST REMOVAL SYSTEM:

A. Description: Vehicle exhaust removal system consisting of flexible hose with overhead hose reels, common ducting system and exhaust fan. System parts shall be from a single manufacturer.

1. Flexible Hose: Type 2, Silicon/Nomex.

a. Maximum Temperature: 600 degrees F.
b. Diameter: 5 inches.
c. Length: 50 feet.

2. Hose Reel: Suitable for holding required hose with automatic spring recoil operation.

3. Duct: Round, aluminum ductwork with straight sections, elbows, drops, roof penetrations, and any required miscellaneous fittings required to exhaust each flexible hose drop to a common exhaust fan.

4. Exhaust Fan (Repair Bays): Cast aluminum pressure blower, AMCA Type B spark resistant for use up to 400 degrees F. Provide Model No. BI-180 as manufactured by Monoxivent Source Capture Systems or an approved equal.

a. Capacity: 4 HP, 5100 CFM @ 3” w.g.
b. Inlet Size: 19” dia.
c. Outlet Size: 13” x 19”.
d. Motor: 208V, 3PH.
e. Discharge Orientation: Top angular down.

1) Access door to provide access to fan wheel.
2) ½-inch mesh birdscreen on fan outlet.
3) Weather cover for outdoor installation.
4) OSHA shaft and belt guard.
5) High temperature paint and grease for operation at specified temperature.
6) Motor heat shield.

5. Exhaust Fan (Weld Shop): Cast aluminum pressure blower, AMCA Type B spark resistant for use up to 400 degrees F. Provide Model No. BI-60 as manufactured by Monoxivent Source Capture Systems or an approved equal.

a. Capacity: 1 HP, 550 CFM @ 0.5" w.g.
b. Inlet Size: 10 inch dia.
c. Outlet Size: 7" x 10".
d. Motor: 208V, 3PH.
e. Discharge Orientation: Top angular down.

1) Access door to provide access to fan wheel.
2) ½-inch mesh birdscreen on fan outlet.
3) Weather cover for outdoor installation.
4) OSHA shaft and belt guard.
5) High temperature paint and grease for operation at specified temperature.
6) Motor heat shield.

6. Accessories: Manufacturer's standard accessories

a. Galvanized Steel Nozzle for 8" Tailpipe with Spring Damper
b. Duct Hangers
c. Equipment mounts

2.4 CENTRAL VACUUM:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, manufacturers specified.

1. Electrolux.
2. Honeywell.
3. Royal.

B. Central Vacuum:

1. Vacuum: Standard features include the following:

a. Square footage: 8,000 sq. ft.
b. Filtration: Permanent self-cleaning filter.
c. Mounting: Wall/column.
d. Dirt Capacity: 4-gallon.
e. CFM: 124.
f. Volts: 120.
g. Amps: 14.5.
h. Automatic Utility Inlet Value: Manufactures standard.
i. Toolkit: 50 foot crush proof On/Off hose, powerhead, telescoping wand, dusting brush, upholstery, crevice tool, hose hanger and mesh bag.
j. Warranty: 5 years.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

D. Color-Coated Finish: Provide appliances with manufacturer's standard finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, color, gloss, and minimum dry film thickness for painted finishes.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

3.2 INSTALLATION:

A. Install exhaust systems equipment level and plumb, and in accordance with manufacturer’s written installation instructions.

B. Support suspended exhaust equipment from structure as detailed on the plans and as per manufacturer’s written instructions. Vibration-control devices are specified in CSI Division 23 Section 230548, “Vibration and Seismic Controls for HVAC Piping and Equipment.”

C. Install all exhaust equipment with clearances for service and maintenance.

D. Install round ducts in maximum practical lengths.

E. Install ducts with fewest possible joints.

F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

H. Install ducts in trenches, close to walls, columns, and other structural and permanent enclosure elements of building.

I. Seal ducts as per manufacturer’s manufactured written instructions.

J. Label all equipment according to requirements specified in Division 23 Section 230553, “Identification for HVAC Piping and Equipment.”

K. Assemble mobile filtration and dust collection units delivered unassembled in accordance with manufacturer's instructions and recommendations.

L. The Equipment Installer shall be responsible for coordinating the installation of the mobile filtration unit with the construction of the facility.

M. Industrial exhaust system shall comply to FMG Data Sheet 7-78.

N. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

O. Utilities: Refer to CSI Division 26 for electrical requirements.

3.3 CONNECTIONS:

A. Install ducts adjacent to exhaust system equipment to allow service and maintenance.

B. Install flexible duct to connect dust collection ducts to equipment as per manufacture's written installation instructions and such that it does not interfere with the units operation.

C. Ground equipment.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL:

A. Engage a factory-authorized service representative to perform equipment start-up on fume exhaust systems and dust collection systems:

1. Equipment Startup Checks:

a. Verify that shipping, blocking, and bracing is removed.
b. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
c. Verify that cleaning is complete.
d. Verify lubrication for bearings and other moving parts.

2. Starting Procedures:

a. Energize motor and adjust fan to indicated rpm.
b. Measure and record motor voltage and amperage.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Engage a factory-authorized service representative to perform equipment start-up on mobile filtration unit:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Verify proper operation of vehicle exhaust removal system.

1. Verify that units is securely mounted and supported and that connections to ducts are complete.
2. Verify operation of reel automatic spring recoil.
3. Energize existing exhaust fan to ensure proper airflow at vehicle side of exhaust removal hose.

D. Verify proper operation of central vacuum system:

1. Test each item of appliances to verify proper operation. Make necessary adjustments.
2. Verify that accessories required have been furnished and installed.
3. Remove packing material from appliances and leave units in clean condition, ready for operation.

3.5 CLEANING:

A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.6 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

END OF SECTION 233823

SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Listed double-wall vents and chimneys.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Working Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.
2. For installed products indicated to comply with design loads, include calculations required for selecting seismic restraints and structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Certified Sizing Calculations.
3. Welding certificates.

B. Manufacturer Seismic Qualification Certification: Submit certification that factory-fabricated breeching, chimneys, and stacks; accessories; and components will withstand seismic forces defined in CSI Division 23 Section 230548 "Vibration and Seismic Controls for HVAC." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Breeching, Chimneys, and Stacks: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of anchorage devices on which the certification is based and their installation requirements.

1.4 QUALITY ASSURANCE:

A. Source Limitations: Obtain listed system components through one source from a single manufacturer.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.

C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

PART 2 - PRODUCTS

2.1 LISTED BUILDING-HEATING-APPLIANCE CHIMNEYS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Metal-Fab, Inc.
2. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
3. Van-Packer Company, Inc.

B. Description: Double-wall metal vents tested according to UL 103 and UL 959 and rated for 1400 deg F continuously, or 1800 deg F for 10 minutes; with positive or negative flue pressure complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1-inch annular space filled with high-temperature, ceramic-fiber insulation.

D. Inner Shell: ASTM A 666, Type 304 stainless steel.

E. Outer Jacket: Aluminized steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.

2.2 GUYING AND BRACING MATERIALS:

A. Cable: Four galvanized, stranded wires of the following thickness:

1. Minimum Size: 5/16 inch in diameter.

B. Pipe: Galvanized steel, NPS 1-1/4, quantity as required.

C. Angle Iron: Galvanized steel, 2 by 2 by 0.25 inch, quantity as required.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION:

A. Listed Building-Heating-Appliance Chimneys: Gas-fired boilers and water heaters.

3.3 INSTALLATION OF LISTED VENTS AND CHIMNEYS:

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Lap joints in direction of flow.

E. Install, support, and restrain according to seismic requirements.

3.4 CLEANING:

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 235100

SECTION 235223 - CAST-IRON BOILERS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes packaged cast-iron boilers, trim, and accessories for generating hot water with the following configurations and burners:

1. Field assembled.
2. Forced-draft, gas burner.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.

a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
b. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and equipment mounting frames.

2. Wiring Diagrams: Power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS:

A. Manufacturer Seismic Qualification Certification: Submit certification that boiler, accessories, and components will withstand seismic forces defined in CSI Division 23 Section 230548 "Vibration and Seismic Controls for HVAC." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Source quality-control test reports.
3. Field quality-control test reports.

C. Warranty: Special warranty specified in this Section.

D. Other Informational Submittals:

1. Startup service reports.

1.4 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For boilers, components, and accessories to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE:

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. I=B=R Compliance: Boilers shall be tested and rated according to HI's "Rating Procedure for Heating Boilers" and "Testing Standard for Commercial Boilers," with I=B=R emblem on a nameplate affixed to boiler.

E. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

F. FM Global Standards (available at www.fmglobal.com):

1. Data Sheet 6-4, “Oil- and Gas- Fired Single Burner Boilers.”

1.6 COORDINATION:

A. Plans indicate size, profiles, and dimensional requirements of cast-iron boilers and are based on the specific system indicated in this Section.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in CSI Division 03.

1.7 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – WARRANTIES for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace controls and heat exchangers of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Heat Exchangers: 10 years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (REPAIR FACILITY):

A. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. 788 Series 2 as manufactured by Weil-McLain; a United Dominion Company or an approved equal.

2.2 MANUFACTURERS: (MAINTENANCE FACILITY):

A. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. 688 Series 2 as manufactured by Weil-McLain; a United Dominion Company or an approved equal.

2.3 MANUFACTURED UNITS:

A. Description: Factory fabricated and field assembled.

1. Ship cast-iron sections disassembled with all materials and equipment, including seals, tie rods, and insulated jacket and flue-gas vent connection for field assembly.

B. Cast-Iron Section Design:

1. Configuration: Wet base.
2. Number of Passes: Single or Multiple.
3. Sectional Joints: High-temperature sealant to seal flue-gas passages not in contact with heating medium, fiber roping, and held together with tie rods.
4. Drain and blowdown tappings.
5. Return injection tube to equalize water flow to all sections.
6. Crown inspection tappings with brass plugs.

C. Combustion Chamber: Equipped with flame observation ports, front and back.

D. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures and powder-coated protective finish.
2. Insulation: Minimum 1-inch-thick, mineral-fiber insulation surrounding the heat exchanger.
3. Access: For cleaning between cast-iron sections.
4. Draft Hood: Flue canopy and top flue connection shall be constructed of aluminized or stainless steel containing adjustable outlet damper assembly.
5. Mounting Frame: Steel rails to mount assembled boiler package on concrete base.

a. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler, accessories, and components with reinforcement strong enough to withstand seismic forces defined in CSI Division 23 Section 230548 "Vibration and Seismic Controls for HVAC" when mounting base is anchored to building structure.

2.4 BURNER:

A. Burner: Welded construction with multivane, stainless-steel, flame-retention diffuser for natural gas.

1. Basis-of-Design Product (Repair Facility): Subject to compliance with requirements, provide Model No. WJ50A-15 as manufactured by Power Flame or an approved equal.

2. Basis-of-Design Product (Maintenance Facility): Subject to compliance with requirements, provide Model No. WJ50A-15 as manufactured by Power Flame or an approved equal.

B. Blower: Forward-curved centrifugal fan integral to burner, directly driven by motor; with adjustable, dual-blade damper assembly and locking quadrant to set air-fuel ratio.

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

C. Gas Train: Control devices and low-high-low control sequence shall comply with requirements in FMG, IRI, UL.

D. Pilot: Intermittent-electric-spark pilot ignition with 100 percent main-valve and pilot-safety shutoff with electronic supervision of burner flame.

E. Interlock: The burner operation circuit shall be electronically interlocked through end switches located on the combustion air dampers which will insure that the combustion air dampers are open before the burner can operate. The combustion air dampers shall close in the event of a flame failure.

2.5 TRIM:

A. Include devices sized to comply with ANSI B31.9, "Building Services Piping."

B. Aquastat Controllers: Operating, firing rate, and high limit.

C. Safety Relief Valve: ASME rated.

D. Pressure and Temperature Gage: Minimum 3-1/2-inch-diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

E. Boiler Air Vent: Automatic.

F. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

2.6 CONTROLS:

A. Refer to CSI Division 23 Section 230900, "Instrumentation and Control for HVAC."

B. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.
2. Low-Water Cutoff Switch: Externally piped type to prevent burner operation on low water. Cutoff switch shall be manual-reset type. Pilot Lights: Provide for “Power On,” “Call for Heat,” “Ignition On, “Fuel On,” “High Cutoff,” “Low-Water,” and “Flame Failure”.
3. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for High Cutoff, Low Water, and Flame Failure.

C. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms. Refer to CSI Division 23 Section 230900, “Instrumentation and Controls for HVAC” and CSI Division 23 Section 230993, “Sequence of Operations for HVAC Controls.”

D. Thermal Safety Switches: Manual-reset type.

E. Emergency Shutoff Switches: Furnish to the Electrical Installer for installation where shown on the Plans.

2.7 ELECTRICAL POWER:

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

2.8 CAPACITIES AND CHARACTERISTICS (REPAIR FACILITY):

A. Heating Medium: Hot water.

B. Design Water Pressure Rating: 50 psig.

C. Safety Relief Valve Setting: 30 psig.

D. Entering-Water Temperature: 180 deg F.

E. Leaving-Water Temperature: 200 deg F.

F. I=B=R Input: 2046 MBh

G. Net I=B=R Output Capacity: 1478 MBh

H. Blower:

1. Motor Horsepower: 1/2.
2. RPM: 3450.

I. Electrical Characteristics:

1. Volts: 120 V.
2. Phase: Single.
3. Hertz: 60.

2.9 CAPACITIES AND CHARACTERISTICS (MAINTENANCE FACILITY):

A. Heating Medium: Hot water.

B. Design Water Pressure Rating: 50 psig.

C. Safety Relief Valve Setting: 30 psig.

D. Entering-Water Temperature: 180 deg F.

E. Leaving-Water Temperature: 200 deg F.

F. I=B=R Input: 1701 MBh

G. Net I=B=R Output Capacity: 1229 MBh

H. Blower:

1. Motor Horsepower: 1/3.
2. RPM: 3450.

I. Electrical Characteristics:

1. Volts: 120 V.
2. Phase: Single.
3. Hertz: 60.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Plans are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION:

A. Equipment Mounting:

1. Install boilers level on a 6-inch thick cast-in-place concrete equipment base, 4-inches larger on each side than base of unit using elastomeric isolator pads or mounts. Dowel base to floor on 18-inch centers along perimeter of base. Cast anchor-bolt inserts through base into floor. Concrete base shall be installed by the Concrete Installer in the location indicated by the Mechanical Installer. Comply with requirements for equipment bases specified in CSI Division 03 Section 033000 “Cast-in-Place Concrete”.
2. Comply with requirements for vibration isolation and seismic control devices specified in CSI Division 23 Section 230548, "Vibration and Seismic Controls for HVAC".

B. Install gas-fired boilers according to NFPA 54.

C. Assemble boiler sections in sequence and seal between each section.

D. Assemble and install boiler trim.

E. Install electrical devices furnished with boiler but not specified to be factory mounted.

F. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS:

A. Piping installation requirements are specified in other CSI Sections. Plans indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

D. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

E. Install piping from safety relief valves to floor adjacent to boiler.

F. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

G. Connect breeching full size to boiler outlet. Comply with requirements in CSI Division 23 Section 235100, "Breechings, Chimneys, and Stacks" for venting materials.

H. Ground equipment according to CSI Division 26 Section 260526, "Grounding and Bonding for Electrical Systems."

I. Connect wiring according to CSI Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL:

A. Arrange for the National Board of Boiler and Pressure Vessel Inspectors to inspect boiler piping, to observe hydrostatic testing, and to certify the completed boiler installation.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions and ASME Boiler and Pressure Vessel Code Section IV.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.
    b. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
    c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

D. Remove and replace malfunctioning units and retest as specified above.

E. Occupancy Adjustments: When requested by the Engineer within 12 months of date of the issuance of the Certificate of Compliance, the Contractor shall provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two

visits to Project Site during other than normal occupancy hours for this purpose at no additional cost to the Department.

3.5 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain boilers.

END OF SECTION 235223

SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:

1. Direct-expansion cooling.
2. Economizer outdoor- and return-air damper section.
3. Roof curbs.

1.2 DEFINITIONS:

A. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

B. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

D. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

E. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.3 PERFORMANCE REQUIREMENTS:

A. Delegated Design: Design RTU supports to comply with wind and seismic performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Wind-Restraint Performance:

1. Basic Wind Speed: Refer to Structural Drawing No. S-002.
2. Building Classification Category: Refer to Structural Drawing No. S-002.
3. Minimum 10 lb/sq. ft multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

C. Seismic Performance: RTUs shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

D. Delegated-Design Submittal: For RTU supports 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. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Wind- and Seismic-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS:

A. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in CSI Division 23 Section 230548 "Vibration and Seismic Controls for HVAC."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Manufacturer Seismic Qualification Certification: Submit certification that RTUs, accessories, and components will withstand seismic forces defined in "Performance Requirements" Article and in CSI Division 23 Section 230548 "Vibration and Seismic Controls for HVAC."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
2. Field quality-control test reports.

D. Warranty: Special warranties specified in Part 1.9, “Warranty.”

1.6 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For RTUs to include in operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of filters for each unit.

1.8 QUALITY ASSURANCE:

A. ARI Compliance:

1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.9 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from the issuance of the Certificate of Compliance.
2. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the Plans as manufactured by Trane; American Standard Companies, Inc., or an approved equal.

2.2 CASING:

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

1. Exterior Casing Thickness: Manufacturer's standard.

C. Inner Casing Fabrication Requirements:

1. Inside Casing: Manufacturer's standard.

D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1. Materials: ASTM C 1071, Type I.
2. Thickness: 1/2 inch.
3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
4. Liner Adhesive: Comply with ASTM C 916, Type I.

E. Condensate Drain Pans: Formed sections of galvanized-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1.

1. Drain Connections: Threaded nipple.
2. Pan-Top Surface Coating: Corrosion-resistant compound.

2.3 FANS:

A. Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, variable speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls. Motor shall have built-in thermal overload protection.

B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor and with built-in thermal overload protection.

C. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in CSI Division 23 Section 230548, "Vibration and Seismic Controls for HVAC" when fan-mounted frame and RTU-mounted frame are anchored to building structure.

2.4 COILS:

A. Supply-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
2. Coil Split: Interlaced.
3. Condensate Drain Pan: Galvanized steel with corrosion-resistant coating formed with pitch and drain connections complying with ASHRAE 62.1.

B. Outdoor-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.

2.5 REFRIGERANT CIRCUIT COMPONENTS:

A. Number of Refrigerant Circuits: Two.

B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

C. Refrigeration Specialties:

1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.

2.6 AIR FILTRATION:

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Manufacturer’s throwaway filters in filter rack.

2.7 DAMPERS:

A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in

reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

1. Damper Motor: Modulating with adjustable minimum position.
2. Relief-Air Damper: Gravity actuated, with bird screen and hood.

2.8 ELECTRICAL POWER CONNECTION:

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.9 CONTROLS:

A. Control equipment and sequence of operation are specified in CSI Division 23 Section 230900 "Instrumentation and Control for HVAC."

B. Operating Controls: Factory-installed microprocessor controls and monitors unit and communicates with central control processor.

1. Control enclosure shall contain all sensors mounted and wired to a numbered terminal strip. Terminal strip to be wired to BAS/ATC System by the BAS/ATC Installer. All wiring shall be color coded, and a wiring diagrams shall be attached to the inside of the unit door.
2. Provide contacts for remote start via the BAS/ATC System.

2.10 ACCESSORIES:

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

C. Hail guards of galvanized steel, painted to match casing.

D. Concentric diffuser with white louvers and polished aluminum return grilles, insulated diffuser box with mounting flanges, and interior transition.

E. Condensate drain traps.

2.11 ROOF CURBS:

A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

a. Materials: ASTM C 1071, Type I or II.
b. Thickness: 2 inches.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

a. Liner Adhesive: Comply with ASTM C 916, Type I.
b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
d. Liner Adhesive: Comply with ASTM C 916, Type I.

B. Curb Height: 14 inches.

C. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in CSI Division 23 Section 230548 "Vibration and Seismic Controls for HVAC" for wind-load requirements.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in CSI Division 07 Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

B. Install wind and seismic restraints according to manufacturer's written instructions. Wind and seismically restrained vibration isolation roof-curb rails are specified in CSI Division 23 Section 230548, "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.3 CONNECTIONS:

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTUs to allow service and maintenance.

C. Duct installation requirements are specified in other HVAC Sections. Plans indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section 233300 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.

3.4 FIELD QUALITY CONTROL:

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE:

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to compressor, coils, and fans.
3. Inspect internal insulation.
4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Clean condenser coil and inspect for construction debris.
9. Remove packing from vibration isolators.
10. Verify lubrication on fan and motor bearings.
11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
12. Adjust fan belts to proper alignment and tension.
13. Start unit according to manufacturer's written instructions.

    a. Start refrigeration system.
    b. Do not operate below recommended low-ambient temperature.
    c. Complete startup sheets and attach copy with Contractor's startup report.

14. Inspect and record performance of interlocks and protective devices; verify sequences.
15. Operate unit for an initial period as recommended or required by manufacturer.
16. Calibrate thermostats.
17. Adjust and inspect high-temperature limits.
18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
19. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:

    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outdoor-air, dry-bulb temperature.
    d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

20. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.

21. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outdoor-air intake volume.

22. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

23. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. Low-temperature safety operation.
    b. Filter high-pressure differential alarm.
    c. Economizer to minimum outdoor-air changeover.
    d. Smoke alarms.

24. After startup and performance testing and prior to the issuance of the Certificate of Compliance, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING:

A. Occupancy Adjustments: When requested by the Engineer within 12 months of the issuance of the Certificate of Compliance, the Contractor shall provide on-site assistance in adjusting system to suit actual occupied conditions. The Contractor shall provide up to two visits to site during other-than-normal occupancy hours for this purpose at no additional cost to the Department.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs."

END OF SECTION 237413

SECTION 238123 - COMPUTER-ROOM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Console computer-room air conditioners.

1.2 PERFORMANCE REQUIREMENTS:

A. Seismic Performance: Computer-room air conditioners shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: For computer-room air conditioners. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS:

A. Seismic Qualification Certificates: For computer-room air conditioners, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Quality Assurance Submittals:

1. Field quality-control reports.

C. Warranty: Special warranty specified in Part 1.9 “Warranty”.

1.5 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For computer-room air conditioners to include in the operation, and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 SPARE PARTS:

A. Furnish spare parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of filters for each unit.

1.7 QUALITY ASSURANCE:

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION:

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from the issuance of the Certificate of Compliance.
2. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 CONSOLE UNITS:

A. Basis-of-Design Product: Subject to compliance with requirements, provide Model No. S9NKUA as manufactured by Panasonic or an approved equal.

B. Description: Split system consisting of evaporator section for wall mounting and remote condensing section.

C. Evaporator Cabinet: Furniture-grade steel with baked-enamel finish; with front access and containing direct-drive centrifugal fans and two-speed motor.

D. Condenser Cabinet: Steel with baked-enamel finish and containing compressor and condenser.

E. Refrigeration System:

1. Compressor: Hermetic, with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.
2. Refrigeration Circuit: Filter/dryer, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.
3. Refrigerant: R-410A.
4. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins.
5. Remote Air-Cooled Refrigerant Condenser: Integral, copper-tube aluminum-fin coil with propeller fan, direct driven.
6. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.

F. Filter: Cleanable.

G. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

H. Control System: Wall-mounted panel with contactors, control transformer with circuit breaker, and solid-state temperature-control modules. Provide solid-state, unit-mounted control panel with start-stop switch and adjustable temperature set point.

1. Low Ambient Controller: Cycles condenser fan to permit operation down to 0 deg F.

2.2 FAN MOTORS:

A. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in CSI Division 26 Sections.

2.3 CAPACITIES AND CHARACTERISTICS:

A. Supply-Air Fan:

1. Number of Fans: One.
2. Airflow: (Hi/Me/Lo): 395/311/230 cfm.

B. Refrigeration System:

1. Unit Energy Efficiency: 17 SEER.
2. Refrigerant Compressor:

a. Total Unit Cooling Capacity: 8500 Btu/h.
b. Number of Compressors: One.

C. Electrical Characteristics:

1. Volts: 208.
2. Phase: Single.
3. Hertz: 60.
4. Full-Load Amperes: 7.6.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances. Install according to ARI Guideline B.

B. Computer-Room Air-Conditioner Mounting: Install using elastomeric pads or elastomeric mounts. Comply with requirements for vibration isolation devices specified in CSI Division 23 Section 230548, "Vibration and Seismic Controls for HVAC."

C. Air-Cooled Refrigerant Condenser Mounting: Install using elastomeric pads, elastomeric mounts, or restrained spring isolators. Attachment shall be continuous to roof deck. Comply with requirements for vibration isolation devices specified in CSI Division 23 Section 230548, "Vibration and Seismic Controls for HVAC."

3.3 CONNECTIONS:

A. Piping installation requirements are specified in other CSI Division 23 Sections. Plans indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Drainage Connections: Comply with applicable requirements in CSI Division 23 Section 232113, "Hydronic Piping." Provide adequate connections for condensate drain.

3.4 FIELD QUALITY CONTROL:

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

E. After startup service and performance test, change filters.

3.5 ADJUSTING:

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.6 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

END OF SECTION 238123

SECTION 238216 - AIR COILS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following types of air coils that are not an integral part of air-handling units:

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil. Include rated capacity and pressure drop for each air coil.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For air coils to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

2.2 WATER COILS:

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the Plans as manufactured by Trane or an approved equal.

B. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.

C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.

D. Source Quality Control: Factory tested to 300 psig.

E. Tubes: ASTM B 743 copper, minimum 0.020 inch thick.

F. Fins: Aluminum.

G. Headers: Cast iron with drain and air vent tappings.

H. Frames: Galvanized-steel channel frame, minimum 16 gauge, 0.064 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Install coils as indicated, level and plumb, and in accordance with manufacturer's written instructions.

B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Straighten bent fins on air coils.

D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS:

A. Piping installation requirements are specified in other CSI Division 23 Sections. Plans indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to coils to allow service and maintenance.

C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in CSI Division 23

Section 230900 "Instrumentation and Control for HVAC," and other piping specialties are specified in CSI Division 23 Section 232113 "Hydronic Piping."

END OF SECTION 238216

SECTION 238233 - CONVECTORS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes hydronic convectors.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories. Include manufacturer's standard color charts showing the full range of colors available for units with factory-applied color finishes. A color selection will not be made until it can be coordinated with other required color selections.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details and dimensions of custom-fabricated enclosures.
4. Indicate location and size of each field connection.
5. Indicate location and arrangement of piping valves and specialties.
6. Include enclosure joints, corner pieces, access doors, and other accessories.

1.3 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For convection heating units to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14

subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2.1 HOT-WATER CONVECTORS:

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on the Plans as manufactured by Vulcan, or an approved equal.

1. Color: Ivory.

B. Heating Elements: Seamless copper tubing mechanically expanded into evenly spaced aluminum fins and rolled into cast-brass headers with inlet/outlet and air vent; steel side plates and supports. Factory-pressure-test element at minimum 100 psig.

C. Front and Top Panel: Minimum 18 gauge steel with exposed corners rounded; removable front panels with tamper-resistant fasteners braced and reinforced for stiffness.

D. Wall-Mounted Back and End Panels: Minimum 20 gauge thick steel.

E. Support Brackets: Locate at maximum 36-inch spacing to support front panel and element.

F. Insulation: 1/2-inch-thick, fibrous glass on inside of the back of the enclosure.

G. Finish: Baked-enamel finish.

H. End Pockets: As required to accommodate piping and accessories depicted on the Plans.

I. Enclosure Style: Sloped top.

1. Bottom Inlet Grille: Punched louver; painted to match enclosure.

a. Painted to match enclosure.

2. Top Outlet Grille: Punched louver; painted to match enclosure.

a. Painted to match enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas to receive convectors for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of convector.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Install convectors level and plumb.

B. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.

3.3 CONNECTIONS:

A. Piping installation requirements are specified in CSI Division 23 Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Plans indicate general arrangement of piping, fittings, and specialties.

B. Connect hot-water convectors and components to piping according to CSI Division 23 Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."

1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.

C. Install control valves as required by CSI Division 23 Section 230900 "Instrumentation and Control for HVAC."

D. Install piping adjacent to convectors to allow service and maintenance.

3.4 FIELD QUALITY CONTROL:

A. Perform the following field tests and inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Convectors will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

D. Straighten bent fins on each convector according to manufacturer's recommendations to the satisfaction of the Engineer.

END OF SECTION 238233

SECTION 238236 - FINNED-TUBE RADIATION HEATERS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes hydronic finned-tube radiation heaters.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories. Include manufacturer's standard color charts showing the full range of colors available for units with factory-applied color finishes. A color selection will not be made until it can be coordinated with other required color selections.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details and dimensions of custom-fabricated enclosures.
4. Indicate location and size of each field connection.
5. Indicate location and arrangement of piping valves and specialties.
6. Include enclosure joints, corner pieces, access doors, and other accessories.

1.3 INFORMATIONAL SUBMITTALS:

A. Quality Assurance Submittals:

1. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For finned tube radiation heating units to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14

subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2.1 HOT-WATER FINNED-TUBE RADIATION HEATERS:

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on the Plans as manufactured by Rittling or an approved equal.

1. Color: Ivory

B. Performance Ratings: Rate finned-tube radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."

C. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on element supports. One end of tube shall be belled.

D. Element Supports: Ball-bearing or nylon bushing cradle type to permit longitudinal movement on enclosure brackets.

E. Front Panel: Minimum 16 gauge steel.

F. Wall-Mounted Back Panel: Minimum 20 gauge steel, full height, with full-length channel support for front panel without exposed fasteners.

G. Support Brackets: Locate at maximum 36-inch spacing to support front panel and element, with non-visible fasteners.

H. Finish: Baked-enamel finish.

I. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 6 inches, integral with enclosure, located for access to hot water control valve.

J. Enclosure Style: Sloped top.

1. Bottom Inlet Grille: Punched louver; painted to match enclosure.

a. Painted to match enclosure.

2. Top Outlet Grille: Punched louver; painted to match enclosure.

a. Painted to match enclosure.

K. Accessories: Filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of finned-tube radiation heaters.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FINNED-TUBE RADIATION HEATER INSTALLATION:

A. Install units level and plumb.

B. Install enclosure continuously around corners, using outside and inside corner fittings.

C. Join sections with splice plates and filler pieces to provide continuous enclosure.

D. Install access doors for access to valves.

E. Install enclosure continuously from wall to wall, unless otherwise noted on the Plans.

F. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

G. Install valves within reach of access door provided in enclosure.

H. Install air-seal gasket between wall and recessed flanges or front cover of fully recessed unit.

3.3 CONNECTIONS:

A. Piping installation requirements are specified in CSI Division 23 Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Plans indicate general arrangement of piping, fittings, and specialties.

B. Connect hot-water finned-tube radiation heaters and components to piping according to CSI Division 23 Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties."

1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.

C. Install control valves as required by CSI Division 23 Section 230900 "Instrumentation and Control for HVAC."

D. Install piping adjacent to finned-tube radiation heaters to allow service and maintenance.

3.4 FIELD QUALITY CONTROL:

A. Perform the following field tests and inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

D. Straighten bent fins on each finned tube radiator according to manufacturer's recommendations to the satisfaction of the Engineer.

END OF SECTION 238236

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Propeller unit heaters with hot-water coils.
2. Propeller unit heaters with electric-resistance heating coils.
3. Cabinet unit heaters with centrifugal fans and hot-water coils.

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include standard wiring diagrams, rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include location and size of each field connection.
4. Include details of anchorages and attachments to structure and to supported equipment.
5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
6. Indicate location and arrangement of piping valves and specialties.
7. Indicate location and arrangement of integral controls.
8. Wiring Diagrams: Power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS:

A. Manufacturer Seismic Qualification Certification: Submit certification that unit heaters, accessories, and components will withstand seismic forces defined in CSI Division 23 Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

A. Quality Assurance Submittals:

1. Field quality-control test reports.

1.4 CLOSEOUT SUBMITTALS:

A. Operation and Maintenance Data: For propeller unit heaters to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 4 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE:

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 PROPELLER UNIT HEATERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Airtherm; a Mestek Company.
2. McQuay International.
3. Trane.

B. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

C. Cabinet: Removable panels for maintenance access to controls.

D. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and tested propeller unit heater before shipping.

E. Discharge Louver: Adjustable fin diffuser for horizontal units.

F. General Coil Requirements: Test and rate hot-water propeller unit heater coils according to ASHRAE 33.

G. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

H. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

I. Fan Motor Type: Permanently lubricated, multispeed, with integral thermal-overload protection.

J. OSHA Fan Guard: Factory installed wire fan guard.

2.2 ELECTRIC PROPELLER UNIT HEATERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Airtherm; a Mestek Company.
2. McQuay International.
3. Trane.

B. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

C. Comply with UL 2021.

D. Cabinet: Removable panels for maintenance access to controls.

E. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.

F. Discharge Louver: Adjustable fin diffuser.

G. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

H. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

I. Motor Type: Permanently lubricated, multispeed, with integral thermal-overload protection.

2.3 CABINET UNIT HEATERS:

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on the Plans as manufactured by Vulcan Radiator, or an approved equal.

1. Color: White.

B. Description: Factory-assembled and -tested unit in recessed ceiling-mount configuration, with factory supplied wall-seal assembly.

C. Cabinet: Electrogalvanized steel, 16 gauge minimum, continuously hinged front panel, with 18 gauge minimum internal, side and top panels. Supplied with adjustable rear mounting brackets.

D. Cabinet Finish: Manufacturer's standard backed enamel.

E. Filter: Reusable aluminum media with 69% arrestance level.

F. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced at 12 per inch.

G. Fan: Centrifugal, forward curved, double width, directly mounted.

H. Fan Motor: Direct-drive, with integral thermal protection.

I. Speed Control: Manufacturer's standard, for remote installation.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. Install propeller unit heaters level and plumb.

B. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers, spring hangers, or spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in CSI Division 23 Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in CSI Division 23 Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install cabinet unit heater speed controls adjacent to heater in plenum.

D. Protect cabinet unit heater filter during building construction.

3.3 CONNECTIONS:

A. Piping installation requirements are specified in CSI Division 23 Section 232113 “Hydronic Piping”. Plans indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Unless otherwise indicated, install union and ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in CSI Division 23 Section 232113, "Hydronic Piping."

D. Ground equipment according to CSI Division 26 Section 260526, "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to CSI Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

F. Temperature control and interlock wiring are specified in CSI Division 23 Section 230900, “Instrumentation and Control for HVAC.”

3.4 FIELD QUALITY CONTROL:

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Units will be considered defective if they do not pass tests and inspections

D. Prepare test and inspection reports.

3.5 ADJUSTING:

A. Adjust cabinet unit heater fan speed to lowest setting that provides for required heat output to space.

3.6 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 5 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain unit heaters.

END OF SECTION 238239

SECTION 238316 - RADIANT-HEATING HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes radiant-heating piping, including:

1. PEX pipe and fittings
2. Distribution manifolds
3. Piping specialties
4. Controls

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. PEX: Crosslinked polyethylene.

1.3 SUBMITTALS

A. Submit the following in accordance with Form 818, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include data for piping, fittings, manifolds, specialties, and controls; include pressure and temperature ratings, oxygen-barrier performance, fire-performance characteristics, and water-flow and pressure-drop characteristics.

2. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: Show piping layout and details drawn to scale, including valves, manifolds, controls, and support assemblies, and their attachments to building structure.

1. Shop Drawing Scale: 1/4 inch = 1 foot.

D. Maintenance Data: to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – OPERATION AND MAINTENANCE MANUALS.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain from a single manufacturer in accordance with Form 818 Article 1.20-1.06.01.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For radiant-heating piping valves and equipment to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PEX PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. REHAU Incorporated.
2. Uponor.
3. Viega.
4. Watts Radiant, inc.; a Watts Water Technologies company.

B. Pipe Material: PEX plastic according to ASTM F876.

C. Oxygen Barrier: Limit oxygen diffusion through the tube to maximum 0.10 mg per cu. m/day at 104 deg F according to DIN 4726.

D. Fittings: Manufacturers cold expansion plastic or brass insertion fittings designed to maintain at least 90% of the internal flow area with press closure.

E. Pressure/Temperature Rating: Minimum 100 psig and 180 deg F.

2.2 DISTRIBUTION MANIFOLDS

A. Manifold: Minimum NPS 1, stainless steel or cold expansion plastic insertion fittings designed to maintain at least 90% of the internal flow area with press closure.

B. Main Shutoff Valves:

1. Factory installed on supply and return connections.
2. Two or three-piece body.
3. Body: Brass or bronze.
4. Ball: Chrome-plated bronze.
5. Seals: PTFE.

6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Key furnished with valve, or screwdriver bit.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

D. Balancing Valves:

1. Body: Plastic or bronze, ball or plug, or globe cartridge type.
2. Ball or Plug: Brass or stainless steel.
3. Globe Cartridge and Washer: Brass with EPDM composition washer.
4. Seat: PTFE.
5. Visual Flow Indicator: Flowmeter with visible indication in a clear plastic cap at top of valve.
6. Handle Style: Lever or knob, with memory stop to retain set position if used for shutoff.
7. CWP Rating: Minimum 125 psig.
8. Maximum Operating Temperature: 250 deg F.

E. Thermometers:

1. Mount on supply and return connections.
2. Case: Dry type, metal or plastic, minimum 2-inch diameter.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, connecting element and pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Black metal.
7. Window: Plastic.
8. Connector: Rigid, back type.
9. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem.
10. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

F. Mounting Brackets: Copper, or plastic- or copper-clad steel, where in contact with manifold.

2.3 PIPING SPECIALTIES

A. Cable Ties:

1. Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
2. Minimum Width: 1/8 inch.
3. Tensile Strength: 20 lb, minimum.
4. Temperature Range: Minus 40 to plus 185 deg F.

B. Floor Mounting Clamps:

1. Two bolts, steel, with corrosion-resistant coating and smooth finish without sharp edges.
2. Minimum Thickness: 3/32 inch.
3. Width: Minimum, wider than tubing.

C. Floor Mounting Tracks:

1. Aluminum or plastic channel track with smooth finish and no sharp edges.
2. Minimum Thickness: 1/16 inch.
3. Slot Width: Snap fit to hold tubing.
4. Slot Spacing: 2-inch or 3-inch intervals as required for the project.

D. Modular Interlocking Blocks:

1. Polypropylene snap-together blocks with grooves to support piping.
2. Galvanized sheet metal or aluminum emission plates.
3. Natural mineralboard cover panel.

2.4 CONTROLS

A. Temperature-control devices and sequence of operations are specified in Section 230900 "Instrumentation and Control for HVAC" and as shown on the control drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive radiant-heating piping for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Ensure that surfaces and pipes in contact with radiant-heating piping are free of burrs and sharp protrusions.

2. Ensure that surfaces and substrates are level and plumb.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings or coordination drawings.

B. Install radiant-heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels.

C. Connect radiant piping to manifold in a reverse-return arrangement.

D. Do not bend pipes in radii smaller than manufacturer's minimum bend radius dimensions.

E. Install manifolds in accessible locations, or install access panels to provide maintenance access as required in Section 083113 "Access Doors and Frames."

F. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties" for pipes and connections to hydronic systems and for glycol-solution fill requirements.

G. Fire- and Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials according to Section 078413 "Penetration Firestopping."

H. Piping in Concrete or Pavement:

1. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.
2. Space cable ties a maximum of 18 inches o.c. and at center of turns or bends.
3. Maintain 3-inch minimum cover.
4. Install a sleeve of 3/8-inch- thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
5. Maintain minimum 40-psig pressure in piping during concrete placement and continue for 24 hours after placement.

I. Revise locations and elevations from those indicated as required to suit field conditions and ensure integrity of piping and as approved by DESIGNER.

J. After system balancing has been completed, mark balancing valves to permanently indicate final position.

K. Perform the following adjustments before operating the system:

1. Open valves to fully open position.
2. Check operation of automatic valves.
3. Set temperature controls so all zones call for full flow.
4. Purge air from piping.

L. After concrete has cured as recommended by concrete supplier, operate radiant-heating system as follows:

1. Start system heating at a maximum of 10 deg F above the ambient radiant-panel temperature and increase 10 deg F each following day until design temperature is achieved.
2. For freeze protection, operate at a minimum of 60 deg F supply-water temperature.

3.3 FIELD QUALITY CONTROL

A. Prepare radiant-heating piping for testing as follows:

1. Open all isolation valves and close bypass valves.
2. Open and verify operation of zone control valves.
3. Flush with clean water and clean strainers.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Leak Test: After installation, charge system and test for leaks. Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than 100 psig. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Radiant-heating piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Protect hydronic piping system from damage during construction.

3.4 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 3 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

END OF SECTION 238316

SECTION 260501 – ELECTRICAL EQUIPMENT FOR FUELING & TANKS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Shunt trip circuit breaker
2. Emergency stop push buttons
3. Low voltage dispenser disconnect (LVDD)
4. Fuel island panelboard
5. Emergency Telephone
6. Overfill alarm and test station
7. Dispenser switches and fuel island light switches

B. Related CSI Sections include the following:

1. Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables"
2. Division 26 Section 260533, "Raceway and Boxes for Electrical Systems"
3. Division 26 Section 262816, “Enclosed Switches and Circuit Breakers”
4. Division 13 Section 132160, “Installation Of New Fuel Facility”
5. Division 13 Section 132180, “Tank Monitoring System”
6. Division 26 Section 260553, "Identification for Electrical Systems" for labeling materials.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20 – 1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For all devices.

C. Shop Drawings: For panelboards. Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:

1. Enclosure type with details for types NEMA 250, Type 1 and others.
2. Bus configuration and current ratings.

3. Short-circuit current rating of panelboard.
4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
5. Wiring Diagrams: Details of schematic diagram including control wiring and differentiating between manufacturer-installed and field-installed wiring.
6. Panelboard Schedule: For installation in panelboards. Submit final versions after load balancing.

1.3 QUALITY ASSURANCE:

A. Comply with NFPA 70.

B. UL and NEMA Compliance: Provide wiring devices and call to aid equipment which are listed and labeled by UL and comply with applicable UL and NEMA standards.

1.4 SEQUENCE AND SCHEDULING:

A. Schedule installation of finish plates after the surface upon which they are installed has received final finish.

PART 2 - PRODUCTS

2.1 DEVICES:

A. Low voltage dispenser disconnect: Square D model No. LVDD-V-4 or approved equal.
1. Low Voltage Dispenser Disconnect shall be UL listed-UL1238 control equipment for use with flammable liquid dispensing devices.
2. Low Voltage Dispenser Disconnect is designed to function as a disconnect for Low Voltage Dispenser wiring. This product is intended to be used at fueling sites to provide compliance to NFPA 30A Section 6.7 and NEC Sections 514.11 and 514.13.

B. Fuel Island Panelboard: GE catalog NO. AQU1302RCXAXB4 or approved equal
1. Fuel Island Panelboard (DP-1) shall be equipped with piano hinged trims, copper tin plated bus, bolt-on circuit branch breakers rated for 22kic.
2. Refer to CSI SECTION 262416 – PANELBOARDS for further panelboard installation requirements.

C. Emergency stop push buttons: Siemens catalog NO. 52PR8MRAB or approved equal

1. Shunt trip mushroom head push button, red led-illuminated with polycarbonate guard, push/twist release button. The shunt trip push button shall be 30 mm in size and equipped with 1 normally open and 1 normally closed contacts.
2. Provide nameplate "Fuel Island Emergency Power Off".
3. The emergency stop switch installed in office area and on exterior of the building shall be wired in parallel and shall trip the shunt trip breaker.
4. Exterior installed push buttons shall be installed in a NEAMA 4X enclosure
5. Interior push buttons shall be installed in a NEAMA 1 enclosure
6. Push buttons enclosure shall be installed with polycarbonate hinge type guard

D. Shunt trip circuit breaker: GE catalog NO. SEHA36AT0060 Or approved equal
   1. 3-pole shunt trip 60 amp main breaker in NEMA type 1 enclosure. Shunt trip shall service DP-1 for disconnection of phase A, B, and neutral. Refer to NEC, article 514. Emergency shutoff must be manually reset by resetting shunt trip circuit breaker.

E. Emergency Telephone: Weather-resistant, wall mounted, ADA compliant emergency telephone that provides two-way communications with the press of a single button. Enclosure shall be cast aluminum with epoxy safety yellow finish, NEMA 3R rated with an LED providing visual indication that a call was received and “HELP” label with braille located next to the pushbutton. Device shall not require any battery or external power. Provide Red Alert Model No. 393AL-001 as manufactured by GAI-Tronics or an approved equal. Provide line seizure relay Model No. LSR-1 as manufactured by Viking Electronics or an approved equal, to allow an existing phone line to be shared with an emergency telephone.

F. Overfill alarm and test stations:
   1. Remote Audible / Visual Alarm Annunciator: Pneumercator RA100 or approved equal
      a. NEMA 4X enclosure
   2. Remote Test station Pneumercator RS2 or approved equal
      a. NEMA 4X enclosure

G. Enclosures: NEMA Type 1 for the Office Facility or as indicated on plans. NEMA Type 4X for the salt shed or as indicated on plans. PVC coated boxes, cabinets, and fittings, approved for use with PVC coated conduit (Permacote or equal).

H. Switches:

   1. AC tumbler-toggle switches: Meeting minimum requirements of UL 20 and further requirements herein specified and of specification grade, heavy duty, of the type indicated on the plans. Switches shall be gray in color.

a. Provide switches that operate in any position and are fully enclosed cup type with entire body and cover of molded phenolic, urea or melamine. Do not use fiber, paper or similar insulating material for body or cover.
b. Equip switches with metal mounting yoke with plaster ears, insulating from the mechanism and fastened to the switch body by bolts, screws, rivets or other substantial means that meet test requirements.
c. Provide a green-colored equipment grounding screw on the yoke.
d. Provide the section of yoke normally intended to bear on the surface outside the box with a minimum overall dimension of 3/4 inch, measured at right angles to the longitudinal axis of the yoke.
e. Make switch contacts between silver or silver alloys.
f. Switches shall be side wired with terminal of screw or combination screw-clamp type. Provide access holes for back wiring.
g. Wiring terminals capable of receiving and holding proper wire sizes as shown below:

Switch Rating	Wire Size, AWG No.
20 amperes	12

2. Switches for Use on Lighting Circuits: Fully rated at 120 or 208 volts, as indicated on the plans.
3. Switches for Power Equipment: Switches controlling outlets other than lighting, such as motors less than 1/4 horsepower may be specification grade, flush type, AC/DC contacts rated ten amperes, 120/208 Volts. Switches controlling straight resistance loads may be snap switches as specified herein, of the proper rating up to 30 amperes at 120-208 volts. Switches used for controlling motors shall be rated for at least the horsepower of the motor controlled.
4. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

a. Arrow-Hart Division, Crouse-Hinds Company.
b. Hubbell, Inc.
c. General Electric.

I. Receptacles and Plugs:

1. General Use: Grounding duplex type, conforming to NEMA WD-1, configuration 5-20R. Bodies shall be of thermosetting plastic supported on a metal mounting strap. Wiring terminals shall be of the screw type, side wired. Receptacles shall be gray in color.
2. Ground Fault Interrupter Receptacle: NEMA Designation 5-20R, duplex, three wire, 20 amperes, 125 volt, ground fault interrupter type with pilot light to indicate if receptacle is working or faulted (tripped). Do not arrange to protect connected downstream receptacles on same circuit unless called for on plans or approved by

Designer. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.

3. Available Manufacturers: Subject to compliance with requirements, manufacturers of other devices offering products which may be incorporated in the work include, but are not limited to, the following:

   a. Arrow-Hart Division, Crouse-Hinds Company.
   b. Square D Company.
   c. Harvey Hubbell, Inc.

J. Device Plates:

1. All device plates shall be 0.040 inch minimum with struck-up beveled edges, void of sharp corners and burrs.
2. Unless otherwise noted herein and on drawings, all device plates for wall outlets and switches shall be brush satin finish stainless steel for office areas and bay areas.
3. Device plates for wall telephone outlets shall contain two openings for RJ45 Jacks. One Jack for voice and the other for data. Wall outlets shall be brush satin finish stainless steel for office areas and bay areas.
4. Device plates for exposed work shall be steel. Plates for wet locations and those installed in the Salt Shed shall be gasketed and shall have in-use type extra-duty covers.
5. Plate-Securing Screws: Metal with head color to match plate finish.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES AND ACCESSORIES:

A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other Work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other Work.

C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

D. Protect devices and assemblies during painting. Install wall plates after painting work is completed.

E. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A. Use properly scaled torque indicating hand tool.

F. Switches and Receptacles: Unless otherwise indicated, mount flush, with long dimension vertical. Wall switches shall be mounted opposite hinge side of door, 4" from door trim, and ganged under one cover where more than one switch is shown. See mounting height detail for mounting heights of the electrical apparatus.

3.2 PROTECTION:

A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.3 FIELD QUALITY CONTROL:

A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

3.4 CLEANING:

A. General: Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 260501

SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

B. Related CSI Sections: The following sections contain requirements that relate to this Section:

1. Division 26 Section 260526, "Grounding and Bonding for Electrical Systems."
2. Division 26 Section 260533, "Raceway and Boxes for Electrical Systems."
3. Division 26 Section 260543, "Underground Ducts and Raceways for Electrical Systems."
4. Division 26 Section 260544, "Sleeve and Sleeve Seals for Electrical Raceways and Cabling."
5. Division 27 Section 270000, "Premises Telephone Wiring" for cabling used for voice and data circuits.
6. Division 27 Section 275116, "Public Address Systems"
7. Division 27 Section 282300, "Video Surveillance"
8. Division 28 Section 283111, "Digital, Addressable Fire-Alarm System."

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20 – 1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following products:

1. 600 volt insulated wires and cables, all sizes
2. All terminals, lugs and wire connectors
3. Specialty cable including but not limited to fire alarm systems, PA system, telephone/data systems, and cable TV.

C. Quality Assurance Submittals

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.3 QUALITY ASSURANCE:

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the NETA and that is acceptable to authorities having jurisdiction. Testing shall be performed by an independent testing agency.

1. Testing Agency's Field Supervisor: Person currently certified by the NETA or the NICET to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Deliver wires and cables according to NEMA WC 26.

1.5 COORDINATION:

A. Coordinate layout and installation of cables with other installations.

B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Wires and Cables:

a. Alcan Aluminum Corporation; Alcan Cable Div.
b. American Insulated Wire Corp.; Leviton Manufacturing Co.
c. Southwire Company
d. Carol Cable Co., Inc.

2. Connectors for Wires and Cables:

   a. Hubbell Power Systems, Inc.
   b. 3M; Electrical Products Division
   c. Monogram Co.; AFC.
   d. Square D Co.; Anderson.

2.2 BUILDING WIRES AND CABLES:

A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3.2 "Wire and Insulation Applications".

B. Rubber Insulation Material: Comply with NEMA WC 3.

C. Thermoplastic Insulation Material: Comply with NEMA WC 5.

D. Conductor Material: Copper.

E. Stranding: All wires shall be stranded.

F. General:

   1. The Contract Plans show the locations, type, size and number of wires and cables to be used for this Contract. Each type shall comply with the Specifications contained herein.
   2. Cables which have been manufactured more than two years prior to installation will not be accepted.
   3. The conductors, unless otherwise noted, shall be soft or annealed copper conforming to ANSI/ASTM B 33 if coated, ANSI/ASTM B 3 if uncoated. In addition, unless otherwise specified, stranded conductors shall have concentric stranding as per ANSI/ASTM B 8.
   4. Cables shall be supplied with both ends of each length sealed against the entry of moisture.

G. 600 Volt Insulated Wires and Cables:

   1. General:

      a. Power, instrumentation, lighting, grounding, and control cable shall be approved for use in wet or dry locations, indoors or outdoors in raceway, wireways, trenches, conduits, underground ducts.
      b. Asbestos, in any form, is prohibited from the cable. This prohibition includes such items as fillers and binding tapes even though the item is encapsulated, or the asbestos fibers are impregnated with binder material.

c. All conductors shall be copper, insulated, 600 Volt, unless otherwise noted. Wire size No.8 and smaller shall be type THHN/THWN-2, unless otherwise noted or shown; wire size No. 6 AWG and larger shall be type THWN-2 or XHHW-2. Type SF-1 or SF-2 shall be used for connections to lighting fixtures.

d. Conductors with higher insulation temperature rating shall be provided as required. Wiring run through continuous LED fixtures shall be rated 90°C, 194°F. Conductors shall be rated and of a type approved for the specific application.

e. All conductors shall be installed in raceways (except as stated in the next paragraph). Refer to CSI Division 26 Section 260533 "Raceways and Boxes for Electrical Systems" and CSI Division 26 Section 260543 "Underground Ducts and Raceways for Electrical Systems."

f. Metal-clad cable (MC) shall only be used in lieu of metallic raceways for troffer lighting fixtures from the fixture to the junction box in the office area only unless otherwise noted on plans. MC cable shall be fully sized, fully rated 600V and shall include a green insulated copper grounding conductor above ceiling to lighting fixtures. MC cable outer jacket shall be steel. An appropriate anti-short device shall be installed at all termination points.

g. Conductor and conduit sizes shown on the drawings are based on copper conductors with Type THHN/THWN-2 or XHHW-2 insulation, unless otherwise noted. Increase conductor and conduit sizes as necessary for other approved insulation types.

h. Aluminum is not approved for conductors or wire.

i. Power conductors shall be a minimum of No. 12 AWG stranded unless otherwise noted. All wire shall be stranded unless otherwise noted. Control conductors shall be a minimum of No. 14 AWG stranded, unless otherwise noted and specified by the different building systems.

j. When the distance from the panel to the first outlet on a 20 Amp 120 Volt circuit exceeds 100 feet and on a 20 Amp 208 Volt circuit exceeds 200 feet, the conductor shall be increased to No. 10 AWG.

k. Wires, conductors, and cables shall be single conductor, except as otherwise specified or indicated on drawings.

l. Building BAS system conductors shall be per manufacturer's requirements.

m. Cable meeting special requirements such as twisted pairs, triads, or individual shielding shall be provided where recommended by the system manufacturer.

n. Conductor insulation shall be color coded.

	208Y/120 Volt (3-Phase) and 240/120 Volt (Single Phase)	
	Phase A	Black
	Phase B	Red
	Phase C	Blue (3-Phase Only)

Neutral	White
Ground	Green

o. Switch leg wiring shall be of the same color code as the corresponding phase.
p. System color coding shall be in accordance with color code furnished by system manufacturer and shown on wiring diagrams.
q. Colors, except colors for conductors No. 4 AWG and larger, shall be factory applied the entire length of the conductors by solid color compound, solid color coating, or colored striping or bands, 2 sets 180° apart. Onsite coloring shall not be done, except color coding by means of paint or tapes is approved only for conductors No. 4 AWG and larger.
r. Voltage rating, manufacturer, type and conductor AWG size indication shall be continuous, factory applied the entire length of each conductor.
s. Joints and splices shall be made in a manner equivalent electrically and mechanically to the conductor itself. Connections shall be of the pressure or compression type.
t. All lugs terminating feeder conductors shall be of the solderless type UL listed for use with copper wire. All lugs and terminals shall be UL listed for 90°C application.
u. Branch circuit connections or joints shall have an approved type solderless connector suitable for copper conductors.
v. Wire connectors shall consist of a phenolic compound body with a cone-shaped coil spring insert and threaded skirt. Outer shell shall be knurled for each grip and capable of use with a wrench or pliers.

H. Fire Alarm Signal Cable:

1. General:

a. Conductors shall be UL listed.
b. Individual conductor color coded with a red identifying stripe colored Fire Department Red. Comply with UL 969 for a system of labeling materials.
c. Size of conductors and number of pairs shall be as shown on the Contract Plans and per the system manufacturer's requirements.
d. All fire alarm cable shall be installed in conduit.
e. In addition to manufacturer requirements, underground conductors shall be rated for underground use.

2. Construction Details:

a. Conductors shall be twisted unshielded pair NFPA 262 (UL 910) Flame Test Compliant Cable.

b. Voltage Rating: 300 volts for power limited conductors and 600V for non-power limited conductors.
c. Stranded conductors shall have seven strands.
d. Smoke Detector Wires: Conductors shall be twisted, paired, unshielded.

I. Voice/Data Cable:

1. General:

a. Cabling between Communication Outlets and the patch panel in the Communication Room shall be as follows:

1) Voice Cable shall be yellow, Category 6 certified cable. Homerun shall be with no splices. Cable shall be four (4) pair, 100 Ohms unshielded twisted pair.
2) Data cable shall be yellow, Category 6 certified cable. Homerun shall be with no splices. Cable shall be four (4) pair, 100 Ohms unshielded twisted pair.
3) Cable for wireless access points shall be Purple Category 6A certified cable. Homerun shall be with no splices. Cable shall be four (4) pair, 100 Ohms unshielded twisted pair.

b. All cabling shall be in full compliance with EIA/TIA-568B Commercial Building Telecommunications Standard. Installation shall be in full compliance with EIA/TIA-569B Commercial Building Standard for Telecommunications Pathways and Spaces.
c. Size of conductors and number of pairs shall be as shown on the Contract Plans and per the system manufacturer's requirements.
d. In addition to manufacturer requirements, underground conductors shall be rated for underground use.

2. Construction Details:

a. Conductors shall be twisted unshielded pair.
b. Conductors shall be labeled as complying with UL1685.

J. 25 Pair Communication Cable with ground kits.
1. Underground rated
2. CAT5e
3. Copper conductor
4. Polymer-Coated corrugated aluminum type Shield
a. Ground Kits – 3M Scotchlok Shield connectors or approved equal
1) Bond to ground bar in the communications room

K. Fuel Island Communication Cable:

1. Cable between Tank Monitoring System (TMS) and Fuel Master Unit (FMU) shall be shielded twisted pair cable, 4-conductor, #24 AWG., or per the manufacturer's recommendation.
2. Cabling between the patch panel and the emergency telephone located on the exterior of the building. The cable shall be unshielded twisted pair cable, Category 6.
3. Cabling between Fuel Master Unit and Data Panel shall be Category 6.
4. Cabling between the Tank Monitoring System and the Data Panel shall be Category 6.

L. PA System Cable:

1. General:

a. Conductors shall be copper. Conductor size and insulation shall be per manufacturer's requirements.

M. Camera System Cable:

1. General:

a. Cable shall be yellow, Category 6 certified cable. Homerun shall be with no splices. Cable shall be four (4) pair, 100 Ohms unshielded twisted pair.

N. Cable TV:

1. General: RG-6/U: NFPA 70, Type CATV:

a. No. 18 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
b. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
c. Jacketed with black PVC or PE.
d. Suitable for indoor installations.

O. Fiber Optic Cable:

1. General:

a. Cable shall be tight-buffered with 50 µm core multimode OM4 fibers per ISO/IEC 11801 with a fiber count of 12.
b. All-dielectric cable construction with UV resistant and flame retardant jacket rated for plenum (OFNP) installation in accordance with NEC Article 770.

c. Suitable for indoor/outdoor installations and complies with ICEA-S-104-696.

2. Construction Details:

a. Cable shall terminate directly to LC connectors with no buffer kit in between.
b. Cable shall be grounded as per manufacturer's requirements.

P. CORS System communications Cable:
1. Low Loss Flexible LMR-600 Coax Cable Double Shielded
a. cable loss of 2.6 db at 1 GHz (per 100 ft).
b. Copper core
c. Outdoor/watertight
d. UV resistant

2.3 CONNECTORS AND SPLICES:

A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3.2 "Wire and Insulation Applications".

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine raceways and building finishes receiving wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 WIRE AND INSULATION APPLICATIONS:

A. Service Entrance: Type RHW or THWN, in raceway.

B. Underground Conductors: XHHW in raceway.

C. Feeders: Type THHN/THWN, in raceway.

D. Branch Circuits: Type THHN/THWN, in raceway.

E. Fire Alarm Circuits: Power-limited, fire-protective, signaling circuit cable.

F. Class 1 Control Circuits: Type THHN/THWN, in raceway.

G. Class 2 Control Circuits: Power-limited cable, concealed in building finishes.

3.3 INSTALLATION:

A. All conductors shall be installed in concealed metal raceways, RGSC, PVC Coated RGSC, PVC, and EMT, in accordance with the NEC except where specifically noted otherwise.

B. Terminals shall be arranged phase A-B-C or 1-2-3 from left to right, top to bottom, and front to back.

C. Branch circuit phase wires shall be connected to separate phases of supply mains to assure balanced condition in that circuit and proper load balance on the panel. Circuit numbers assigned on drawings are used for convenience and need not necessarily designate the circuit on the panel to which that circuit may be connected. Actual circuiting shall suit job conditions.

D. Equipment requiring electric service is also named on the plans or schedules of other disciplines, or in other Sections. Where receptacles or convenience outlets are specified to serve named equipment, the Contractor shall provide approved receptacle, plug, connection, and/or liquid-tight flexible conduit to equipment.

E. Plans do not necessarily indicate the required number of conductors in each raceway. Unless it is specifically noted that raceways are empty by the word "spare", the Contractor shall provide all required conductors, power, control, supervisory, alarm, or branch circuits. The Contractor shall make all final connections, flexible or fixed, as required, to all equipment requiring final electrical connections.

F. Regardless of the number of conductors shown, each circuit (conductors No. 8 and smaller) to panels or equipment shall contain a full size neutral conductor, which, if not used, shall be taped and insulated at the final point of connection to equipment.

G. All grounding conductors shall have green color coded insulation and shall be sized in accordance with the NEC.

H. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."

I. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

J. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

K. Cables shall be in conduit except where specifically noted otherwise and shall be supported according to CSI Division 26 Section 260529, "Hangers and Supports for Electrical Systems."

L. Identify wires and cables according to CSI Division 26 Section 260553, "Identification for Electrical Systems."

3.4 CONNECTIONS:

A. Conductor Splices: Keep to minimum.

B. Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than conductors are being spliced.

C. Use splice and tap connectors compatible with conductor material.

D. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

E. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL:

A. Testing: Agency: An independent qualified testing agency to perform tests and inspections.

B. Testing: On installation of all wires, feeders, branch circuit conductors, including conductors of all systems, and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

   a. Check for electrical continuity of circuits and for short circuits.

b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

3. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

   a. Verify grounding connections.

4. Test and Inspection Reports to be Submitted: Prepare a written report to record the following:

   a. Procedures used
   b. Results that comply with requirements.
   c. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

5. Cables will be considered defective if they do not pass tests and inspections.

C. Correct malfunctioning conductors and cables at Project Site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new conductors and retest.

END OF SECTION 260519

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Related CSI Sections include the following:

1. Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables".

2. Division 26 Section 260533, "Raceways and Boxes for Electrical Systems".

3. Division 26 Section 260543, "Underground Ducts and Raceways for Electrical Systems".

4. Division 13 Section 132160, "Installation of New Fuel Island

C. System grounding shall be as shown on the plans. All grounding conductors incorporated to the existing system shall be approved by the Engineer.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following:

1. Ground rods.
2. Hardware including clamps, connectors, etc.

C. Qualification Data: For firms and persons specified in Part 1.3, "Quality Assurance".

D. Field Test Reports: Submit written test reports to include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.3 QUALITY ASSURANCE:

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the NETA and that is acceptable to authorities having jurisdiction. Testing shall be performed by an independent testing agency.

1. Testing Agency's Field Supervisor: Person currently certified by the NETA to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with UL 467 for grounding and bonding materials and equipment.

C. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

D. Comply with NFPA 780 and UL 96 when interconnecting with a lightning protection system.

1.4 APPLICABLE STANDARDS:

A. Pertinent provision of the following listed standards shall apply to the Work of this Section, except as they may be modified herein, and are hereby made a part of this Specification to the extent required:

1. NFPA:

a. 70, National Electrical Code.
b. 72, National Fire Alarm Code.
c. 780, Lightning Protection Code.
d. 110, Emergency and Standby Power Systems.

2. IEEE:

a. Standard 80, IEEE Guide for Safety in Substation Grounding.
b. Standard 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
c. Standard 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems.

3. ASTM:

a. B 227, Hard-Down Copper-Clad Steel Wire.

b. B 229, Concentric-Lay-Stranded Copper and Copper-Clad-Steel Composite Conductors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Grounding Conductors, Cables, Connectors, and Rods:

a. Galvan Industries, Inc.
b. Lightning Master Corp.
c. Salisbury: W.H. Salisbury & Co., Utility
d. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS:

A. Ground Cable: annealed concentric stranded, copper cable the size shown on the plans and in accordance with ASTM 8 and Article 250 of the NEC. For insulated conductors, comply with CSI Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables".

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Annealed, concentric stranded, copper cable sized in accordance with ASTM B 8 and Article 250 of the NEC.

F. Underground Conductors shall be bare, tinned, stranded, unless otherwise indicated.

G. Bare Copper Conductors: Only the counterpoise wire shall be bare copper conductor all other conductor in conduit shall be insulated. Bare Copper Conductor shall comply with the following:

a. Assembly of Stranded Conductors: ASTM B 8.

H. Copper Bonding Conductors: Bonding conductors shall be as specified below unless otherwise noted on the plans:

a. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
b. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
c. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

I. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS:

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items. All below–grade (embedded or buried) copper grounding cable connections shall be made by exothermic welding. Bolted connectors shall be acceptable for application where the ground rod or equipment requires periodically disconnection/connection. Connections to stainless steel cables shall be welded.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions. Exothermic welded connectors shall be Erico products Company, Cadweld or approved equal.

D. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.4 GROUNDING ELECTRODES:

A. Ground Rods: Ground rods shall be pointed, copper-clad steel, 3/4-inch in diameter and ten feet long (minimum) or as shown on plans.

PART 3 - EXECUTION

3.1 APPLICATION:

A. All electrical equipment enclosures and equipment, and all metallic parts of the installation, including structures, metallic conduits, wireways, frames, hand-rails, ladders, platforms, fence and metalwork, shall be bonded and connected to the nearest ground cable, whether shown on the Plans or not. Use only copper

conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors. The electrical continuity of wireways, air ducts, fence, enclosures, and handrails shall be maintained by bonding. Bonding of electrical raceway and enclosures shall assure electrical continuity and the capacity to conduct safety and fault current that could be imposed. Bonding shall comply fully with Article 250 of the NEC.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections. Grounding connections shall be made in accordance with the Contract and as specified. Paint, scale, rust, corrosion, and other foreign matter shall be removed from the points of contact on metal surfaces before ground connections are made.

D. Ground tap connections to equipment shall be made at the points provided on the equipment for grounding in accordance with the equipment manufacturer's recommendations. Connections from ground conductors to the ground buses of switchgear, switchboards, power centers, motor control centers, and other cabinet-mounted equipment shall be made by means of an acceptable bolted fittings.

E. All electrical power equipment shall be provided with a ground-fault-current return path. Motors and power receptacles shall utilize a grounded, identified separate grounding conductor in the feeder or branch circuit raceway which connects the motor frame or receptacle to the panelboard ground bus.

F. All electrical power equipment, other than motors and receptacles, shall be provided with a grounded, identified grounding conductor, unless rigid steel conduit in accordance with NEC 344, is used for the raceway.

G. The Grounding conductor shall in no case be a system neutral or a current-carrying conductor. Where a circuit consists of two or more power conductors in a conduit or wiring channel, the grounding conductor may be one standard wire size smaller than the power conductor, but in no case smaller than No. 14 nor larger than No. 4/0, and shall be stranded and covered by green insulation. In all cases, the white insulated wire shall be used for the current-carrying neutral only.

H. Metallic sheaths or shields of shielded cable for power and control shall be terminated by a copper grounding strip provided with a connector for connection to the station ground. The manufacturer of the cable shall furnish instructions for ground termination of shielded cable.

3.2 EQUIPMENT GROUNDING CONDUCTORS:

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.

D. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

E. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.

F. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

G. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

H. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

I. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

J. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and

antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

K. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

L. Common Ground Bonding: Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

1. Ground the steel framework of the building with a driven ground rod at the base of every corner column and at intermediate exterior columns at distances not more than 60 feet apart. Provide a grounding conductor (counterpoise), electrically connected to each ground rod and to each steel column, extending around the perimeter of the building at locations indicated on the plans. Use tinned-copper conductor for counterpoise and for tap to building steel (sizes as shown on plans). Bury counterpoise not less than 30 inches below grade and 36 inches from building foundation.
2. Use bonding conductor sized the same as system grounding electrode conductor, and install in conduit as detailed on the plans.
3. Verify also that the waterline entering the building is 10’ minimum distance in solid earth for an effective ground. Jumper each side of water meter together and bond to the grounding grid.

M. Provide lightning protection/grounding for AST. Refer to specification 132160. All metallic parts shall be bonded with a #2 AWG bare copper stranded conductor connected to #2 AWG bare copper stranded grounding ring using exothermic welds. Grounding rods connected to grounding ring using exothermic welds.

N. Grounding Handholes: Install a driven ground rod through handhole floor or outside the handhole, close to wall, and set rod depth so 4 inches will extend above the bottom of handhole. If necessary, install ground rod before manhole is placed and provide No. 8 AWG bare, tinned-copper conductor from ground rod into handhole through a waterproof sleeve in handhole wall. Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, handhole cover, and cable shields within each handhole, to ground rod or grounding conductor. Make connections with No. 8 AWG minimum bare, stranded, annealed copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. In addition grounding for all utility handholes shall be per utility requirements.

O. Pad Mounted Transformer: Grounding and bonding per the Electric Utility requirements.

3.3 METAL FENCE GROUNDING

A. Where metal fences are located within 16 Ft of the exposed electrical conductors or equipment, the fence shall be bonded with wire type bonding jumpers to the grounding electrode system as follows:

a. Gates and Other Fence Openings: Ground fence on each side of opening.

1) Bond metal gates to gate posts.
2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.

B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.

C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.

D. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

E. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.4 INSTALLATION:

A. All grounding electrodes included but not limited to, Metal underground water pipe, metal frame of the building structure, concrete cased structure, grounding ring, rod and pipe electrodes, shall be bonded together to form the grounding electrode system.

B. Ground Rods: Install one ground rod at least at one-rod length from each other. If the 25 ohms resistance to ground cannot be accomplished add an extra ground rod, unless if two rods are shown on the plans.

1. Drive ground rods until tops are 6 inches below finished floor or final grade, unless otherwise indicated.

C. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

D. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic

structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

E. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at both sides of water meter. Verify that water line is 10' minimum in the earth for an effective ground (no gravel).

F. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

G. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

H. Generator enclosure and all metallic parts shall be bonded.

3.5 CONNECTIONS:

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each

conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

F. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.6 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING:

A. Underground Conduits: Install a grounding conductor with at least 50 percent ampacity of the largest phase conductor in the duct bank.

B. Ground handhole as specified in Section 3.2 M and N.

3.6 FIELD QUALITY CONTROL:

A. The Contractor shall engage an independent testing agency shall perform a program of field testing of installed grounding and bonding systems. Field testing shall be thorough, continuing throughout the installation, fully documented, with the following as a minimum:

1. Electrical resistance tests shall be made during installation to verify continuity of the grounding system.
2. The Electrical Contractor shall contract an independent testing agency to perform a ground Megger Test. The Engineer shall be notified at least 5 days prior to the test. Ground and weather conditions shall be noted at the time of the test. The Contractor shall provide additional grounding equipment until the ground resistance is measured at consistently less than 25 ohms under dry conditions

B. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal.

Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.

3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

    a. Equipment Rated 500 kVA and Less: 10 ohms.
    b. Equipment Rated 500 to 1000 kVA: 5 ohms.
    c. Equipment Rated More Than 1000 kVA: 3 ohms.
    d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
    e. Manhole Grounds: 10 ohms.

4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

C. Prepare test and inspection reports and submit reports of all the ground resistance measurements.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

1.2 PERFORMANCE REQUIREMENTS:

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following:

1. Steel slotted support systems hardware, and accessories.

2. Clamps, fasteners, anchors, hangers, brackets.

C. Working Drawings: For the following:

1. Trapeze hangers.
2. Steel slotted channel systems.
3. Equipment supports.

D. Welding certificates.

1.4 QUALITY ASSURANCE:

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.5 COORDINATION:

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in CSI Division 07 Section 077200, "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS:

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. Thomas & Betts Corporation.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4. Stainless steel or PVC coated galvanized for the corrosive locations (i.e. Salt Shed, Wash Bay, etc.).
3. Nonmetallic Coatings required for corrosive locations: Manufacturer's standard PVC coated or Stainless steel. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported. PVC coated or Stainless steel required for corrosive locations.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported.

Body shall be malleable iron. Provide stainless steel or PVC coated galvanized supports for conduit installed in the corrosive locations (i.e. Salt Shed, Wash Bay, etc.).

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used. Fasteners installed in corrosive locations (i.e. Salt Shed, Wash Bay, etc.) should be Stainless Steel.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type. (Stainless steel in corrosive locations (i.e. Salt Shed, Wash Bay, etc.)).
7. Hanger Rods: Threaded steel. (Stainless steel in corrosive locations (i.e. Salt Shed, Wash Bay, etc.)).

G. Hardware: For corrosive areas (i.e. salt shed) and wet locations (i.e. wash bay) all hardware shall be stainless steel. For all other areas use zinc plated hardware.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES:

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION:

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, RGSC, PVC coated RGSC, and PVC as required by scheduled in NECA 1, where it's Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps or approved clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION:

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified herein.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, RGSC, PVC coated RGSC, and PVC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts. Or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS:

A. Comply with installation requirements in CSI Division 05 Section 055000, "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

D. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING:

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in CSI Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Raceways include the following: RGSC, PVC externally coated rigid steel conduits, PVC, EMT, LFMC, FMC, and wireways.

2. Boxes, enclosures, and cabinets include the following: Device boxes, outlet boxes, pull and junction boxes, cabinets and hinged-cover enclosures.

B. Related CSI Sections include the following:

1. Division 07 Section 078413,"Penetration Firestopping"
2. Division 26 Section 260519, “Low Voltage Electrical Power Conductors and Cables”.
3. Division 26 Section 260526, “Grounding and Bonding for Electrical Systems”.
4. Division 26 Section 260529, “Hangers and Supports for Electrical Systems”.
5. Division 26 Section 260543, “Underground Ducts and Raceways for Electrical Systems”.
6. Division 26 Section 262726, "Wiring Devices"

1.2 DEFINITIONS:

1. EMT: Electrical metallic tubing.
2. FMC: Flexible metal conduit.
3. LFMC: Liquidtight flexible metallic conduit.
4. PVC: Polyvinyl Chloride Conduit
5. RGSC (GRC): Rigid galvanized steel conduit.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20 -1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For surface raceways, wireways and fittings, hinged-cover enclosures, and cabinets.

C. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
2. For boxes, including the following:

a. Conduit entry provisions, including locations and conduit sizes
b. Box cover design
c. Grounding details
d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons
e. Joint details
f. Seals and expansion fittings

1.4 QUALITY ASSURANCE:

A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

B. Comply with NEC's "Standard of Installation."

C. Comply with NFPA 70.

1.5 COORDINATION:

A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Metal Conduit and Tubing:

a. Alflex Corp.
b. Anamet, Inc.; Anaconda Metal Hose.
c. Anixter Brothers, Inc.

2. Conduit Bodies and Fittings:

a. American Electric; Construction Materials Group.
b. Crouse-Hinds; Div. of Cooper Industries.
c. Emerson Electric Co.; Appleton Electric Co.

3. Metal Wireways:

a. Hoffman Engineering Co.
b. Keystone/Rees, Inc.
c. Square D Co.

4. Surface Metal Raceways:

a. Airey-Thompson Co., Inc.; A-T Power Systems.
b. American Electric; Construction Materials Group.
c. Butler Manufacturing Co.; Walker Division.

5. Boxes, Enclosures, and Cabinets:

a. American Electric; FL Industries.
b. Butler Manufacturing Co.; Walker Division.
c. Crouse-Hinds; Div. of Cooper Industries.

2.2 CONDUIT AND TUBING:

A. All conduits shall be ¾" minimum unless otherwise noted.

B. RGSC: ANSI C80.1 and UL 6. Use threaded rigid steel conduit fittings.

C. Plastic-Coated Steel Conduit and Fittings: UL6, ETL PVC-001, coating thickness: 0.040 inch, minimum.

D. RNC (Schedule 80): NEMA TC2, Type EPC-80-PVC, UL 651, with matching fittings, complying with NEMA TC 3 and UL 514B. Solvents and adhesives as recommended by conduit manufacturer.

E. EMT and Fittings: ANSI C80.3 and UL 797. Fittings: Set-screw or compression type. Cast fittings shall be made of steel or malleable iron. Comply with NEMA FB 2.10.

F. LFMC: UL 360, Flexible steel conduit with PVC jacket.

G. FMC: UL ASNI/UL-1, Zinc-coated steel.

H. Fittings/Conduit bodies for Metallic Conduit: Comply with NEMA FB 1 and UL 514B; match conduit/tubing materials. Cast fittings shall be made of steel or malleable iron, hot-dip galvanized finish for RGSC. Covers for conduit bodies installed in wet locations shall be gasketed.

I. Fittings/Conduit bodies RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

J. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

K. Explosion Proof Fittings: Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70. Threaded, recessed-type, close-up plugs. Screwdriver slotted close-up plugs shall not be accepted. Fittings shall be made of malleable iron.

L. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

M. Solvent Cement and Adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 METAL WIREWAYS:

A. Material: Sheet metal sized and shaped as indicated. The exterior installed wireways shall be stainless steel 4X as indicated on plans. Interior installed wireways shall be NEMA 1 and NEMA 4X in interior wet locations (i.e. washbay).

B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

D. Wireway Covers: Hinged type.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS:

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.

B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.5 BOXES, ENCLOSURES, AND CABINETS:

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations. Boxes, enclosures, and cabinets installed in corrosive locations (i.e. Salt Shed) shall be stainless steel, or PVC coated.

B. Sheet Metal outlet and Device Boxes: NEMA OS 1 and UL 514A.

C. Cast Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Boxes and fittings: Boxes and fittings shall comply with the applicable provisions of NFPA 70, Article 314.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum, galvanized, or cast iron with gasketed cover.

H. Nonmetallic Junction Boxes: Comply with NEMA OS 2 and UL 514C.

I. Hazardous (Classified) Location Boxes: Constructed of malleable iron. Appropriate Class and Group classification for the area installed.

J. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic finished inside with radio-frequency-resistant paint.

K. Cabinets: NEMA 250, Type 1, galvanized steel box (Type 4, Stainless Steel for wet locations). Hinged door in front covers with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS:

A. Indoors: Use the following wiring methods:

1. Office Areas: EMT inside finished wall and above ceiling. RGSC when surface mounted in office areas.
2. Damp locations: RGSC.
3. Wet location (e.g. wash bays): PVC coated RGSC up to 10' elevation AFF, PVC over 10' elevation AFF.
4. Electrical Room, Mechanical Room: RGSC up to 10' elevation AFF, EMT over 10' elevation AFF.
5. Concealed conduit in all finished walls shall be EMT.
6. Bay Area: RGSC conduit up to 10' elevation AFF, EMT over 10' elevation AFF.
7. Salt Shed: PVC coated RGSC up to 10' elevation AFF, PVC over 10' elevation AFF.
8. Boxes and Enclosures: NEMA 250, Type 1, except as follows:

(a) Corrosive Locations (e.g. salt shed): NEMA Type 4X, stainless steel.
(b) Damp locations: NEMA 250, Type 4, nonmetallic
(c) Wet Location: PVC coated steel boxes and fittings or stainless steel, approved for use with PVC coated conduit (Permacote or equal) below 10' elevation AFF. PVC boxes and fittings shall be installed above 10' elevation AFF.

B. Outdoors: Use the following wiring methods:

1. Exposed Conduit: Exposed conduit installed above 2' AFG shall be RGSC. Exposed conduit installed 2' AFG and below shall be PVC coated RGSC in paved areas RGSC in grass areas.
2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
3. Boxes and Enclosures, Aboveground : NEMA 250, Type 3R, (NEMA 4X stainless steel wireways) except as follows:

(a) Corrosive Locations (e.g. salt shed): NEMA Type 4X, stainless steel.
(b) Hazardous locations: Appropriate Class and Group classification for the area installed.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings.
2. PVC externally coated, RGS: use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fittings manufacturer. Conduit bodies for PVC RGS conduit shall be made of steel or iron.
3. EMT: Use Set-screw or compression type, steel or malleable iron fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20

3.3 INSTALLATION:

A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions, following NEC and local codes. Install conduit clamps within 3’ of boxes and at 10’ maximum distance between junction points.

B. Minimum Raceway Size: 3/4-inch trade size.

C. Conceal conduit and EMT, unless otherwise indicated, within finished walls and ceilings.

D. Keep raceways at least 6 inches away from parallel runs of flues and hot-water pipes. Install horizontal raceway runs above water and steam piping.

E. Install raceways level and square and at proper elevations. Provide adequate headroom.

F. Complete raceway installation before starting conductor installation.

G. Support raceways as specified in CSI Division 26 Section 260529, "Hangers and Supports for Electrical Systems."

H. Use temporary closures to prevent foreign matter from entering raceways.

I. Stub-ups shall be rigid conduit. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab. RGSC shall be utilized under slab. Under slab installations shall be limited only for the penetration of utilities.

J. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

K. Use raceway fittings compatible with raceways and suitable for use and location. For rigid steel conduit, use threaded rigid steel conduit fittings.

L. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.

M. Install exposed raceways parallel or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.

1. Run parallel or banked raceways together, on common supports where practical.
2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

N. Join raceways with fittings designed and approved for the purpose and make joints tight.

1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
2. Use insulating bushings to protect conductors.

O. Tighten set screws of threadless fittings with suitable tools.

P. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.

Q. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.

R. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire. Ends shall be capped.

S. Telephone, Fire Alarm, and Signal System Raceways: 3-Inch trade size and smaller unless otherwise indicated. In addition to the above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent, unless otherwise indicated. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

T. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where otherwise required by NFPA 70.

U. Stub-up Connections: Extend rigid metal conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor.

V. Flexible Connections: Use maximum of 6 feet of FMC conduit for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC conduit in wet or damp locations. Install separate ground conductor across flexible connections.

W. PVC Externally Coated, Rigid Steed Conduits: Use only fittings approved for use with the material. Mounting hardware shall be stainless steel. Patch all nicks and scrapes in PVC coating after installing conduits.

X. PVC: Use only fittings approved for use with the material.

Y. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or fixture ground terminals.

1. Select each surface raceway outlet box, to which a lighting fixture is attached, of sufficient diameter to provide a seat for the fixture canopy.
2. Where a surface raceway is used to supply a fluorescent lighting fixture having central-stem suspension with a backplate and a canopy (with or without extension ring), no separate outlet box is required.
3. Provide surface metal raceway outlet box, and the backplate and canopy, at the feed-in location of each fluorescent lighting fixture having end-stem suspension.

Z. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

AA. Conduits entering enclosures, other than threaded cast boxes, shall be securely fastened by means of two lock-nuts, one on each side of the enclosure. The conduit shall be terminated in a bushing. Conduit bushings made entirely of non-metallic materials shall not be used.

BB. Do not leave any box openings exposed. Install hole plugs on any knockout holes that are removed without any conduit attached.

CC. Install boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances. Flush mounted boxes shall be galvanized steel.

DD. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

EE. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

FF. Where portions of a cable raceway or sleeve are known to be subjected to different temperatures and where condensation is known to be a problem, as in cold storage areas of the building or where passing from the interior to the exterior of the building, the raceway or sleeve shall be filled with an approved material to prevent the circulation of a warm air to a colder section of the raceway or sleeve.

GG. Raceways shall be provided with expansion fittings where necessary to compensate for thermal expansion and contraction.

HH. Threaded conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

3.4 PROTECTION:

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure coatings, finishes, and cabinets are without damage or deterioration at the issuance of the Certificate of Compliance.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.5 CLEANING:

A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This section includes underground electrical work including the following:

1. Underground conduits and conduit accessories.
2. Handholes

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR SUBMITTALS.

B. Product Data: For the following:

1. Underground conduits
2. Conduits and their accessories, including elbows, end bells, bends, and fittings, and solvent cement.

C. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Handholes
2. Conduit entry provisions, including locations and conduit sizes.
3. Reinforcement details
4. Frame and cover design and frame support rings
5. Grounding details
6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
7. Joint details.

1.3 DEFINITIONS:

A. RGSC: Rigid galvanized steel conduit

B. RNC: Rigid nonmetallic conduit

1.4 QUALITY ASSURANCE:

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.5 SEQUENCING AND SCHEDULING:

A. Coordination of the Work: Coordinate layout and installation of handholes with final arrangement of conduits as influenced by actual final location of other utilities in the field. Coordinate elevations of conduits' entrances into handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and assure duct drain to handholes and as approved by the Engineer.

PART 2 - PRODUCTS

2.1 CONDUIT: (locations as indicated on drawings)

A. Minimum size shall be ¾ inches.

B. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1 and UL6.

C. RNC (Schedule 80): NEMA TC2, Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

D. Plastic-Coated Steel Conduit and Fittings: UL6, ETL PVC-001, coating thickness: 0.040 inch, minimum.

E. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.2 RACEWAY/DUCT SEALING COMPOUND:

Compound: Nonhardening, putty-like consistency workable at temperatures as low as 35°F. Compound shall not slump at a temperature of 300°F and shall readily adhere to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and the common metals. Compound shall have no injurious effect on worker's hands or materials.

2.3 PRECAST CONCRETE HANDHOLES AND BOXES:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to the following:

1. Crownwell Concrete Products, Inc.
2. Carder Concrete Products
3. Christy Concrete Products

B. Frames and Covers:

1. East Jordan Iron Works, Inc.
2. Campbell Foundry Co.
3. Neenah Foudry Co.

C. Reinforced concrete, monolithically poured walls and bottom, with frame and access door assembly as the top of the handhole. Conduit entrances shall be as shown in the handhole details included in the plans. Cover shall have non-skid finish. When buried, handhole shall be designed to support AASHTO H20 loading. The handhole frame and cover shall be mounted one inch above the surrounding finished grade. The frame and cover shall be galvanized steel Refer to handhole details provided on plans.

D. All castings shall be ASTM A-48, CLASS 35b and conform to the dimensions shown on the plans. All castings shall be thoroughly cleaned and given two coats of approved bituminous paint.

E. Cover Legend: Cast in. Selected to suit system.

1. Legend: “ELECTRIC” for duct systems with power wires and cables for systems operating at 600V or less.
2. Legend: “COMMUNICATION” for duct systems with power wires and cables for systems operating at 300V or less.

F. Utility Service Handholes

1. All utility service handholes shall be per the utility requirements.

2.4 TRENCHING AND BACKFILLING MATERIALS:

A. The materials for this work for the encasement of conduit or cable, shall be bedding material, all of which passes a 3/8-inch sieve, and not more than 10% passes a No. 200 (75-micron) sieve. Topsoil, fertilizer, seed and mulch shall conform to Section M.13. Pavement and sidewalk shall conform to Sections M.02, M.03 and M.04.Bituminous Concrete – Class 2 shall conform to Form 818 Article M.04.01.

B. Backfill shall consist of satisfactory soil materials free of clay, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter. Satisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP. Satisfactory material encountered during the excavation may be stored in segregated stockpile for re-use as backfill.

PART 3 - EXECUTION

3.1 UNDERGROUND CONDUITS:

A. All underground conduits shall contain a pull wire, Greenlee No. 430 Poly Pull Line or equal, approved by the Designer. Install underground duct for primary power service per requirements of the utility company. All spare conduits shall be capped. Use PVC schedule 80 under pavement or as indicated in the plans. Provide PVC coated RGSC for sweeps/stub-ups located in bituminous pavement and walkways.

B. RNC:

1. PVC conduit shall be installed in locations indicated on drawings. All non-metallic conduits shall be installed in accordance with manufacturer's instructions.
2. For all conduit runs for the Fuel Island, motor fuel and any other conduit that are installed in Hazardous Locations. RGSC and PVC coated RGSC shall be used for the last two (2) feet of underground run to emergence or the point of connection to the aboveground raceway in accordance with NEC 514.8, Exception No. 2 and NEC 515.8(A). Hazardous Locations conduits routed to handholes shall transition to RGSC for the last 2’ to the point of connection to the handhole.
3. Termination of conduits in handholes or other concrete structures shall be made with end bells.
4. All conduit runs shall leave or enter structures perpendicularly.

C. RGSC:

1. RGSC conduit shall be installed in locations indicated on drawings. All metallic conduits shall be installed in accordance with manufacturer’s instructions.
2. Termination of conduits in concrete structures shall be made with end bells.
3. All conduit runs shall leave or enter structures perpendicularly.

D. PVC Coated RGSC:

1. RGSC conduit shall be installed in locations indicated on drawings. All metallic conduits shall be installed in accordance with manufacturer's instructions.
2. PVC coated RGSC for sweeps/stub-ups located in bituminous pavement and walkways.
3. Termination of conduits in concrete structures shall be made with end bells. All conduit runs shall leave or enter structures perpendicularly.

E. Elbows or bends shall be in accordance the NEC.

F. Transition between conduits of different materials shall be made using the manufacturer's standard adapters.

G. Slope: Pitch ducts a minimum slope of 1:300 down toward handholes and away from buildings and equipment. Slope ducts from a high point in runs between two handholes to drain in both directions.

H. Wall Penetrations: Make a transition from PVC to rigid steel conduit at least 5 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in CSI Division 26 Section 260544, "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

I. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

J. Pulling Cord: Install test Greenlee No. 430 Poly Pull Line nylon cord in conduits, including spares.

3.2 CONDUIT – CLEANING AND TESTING:

A. After conduits and accessories have been installed and all concreting operations, if any, completed, carefully clean and clear all conduit runs of all obstructions and foreign matter to the satisfaction of the Engineer.

B. Test conduits in the presence of the Engineer by pulling through each conduit 20 foot lengths of single conductor, Type THHN-THWN cable of the size and number given in the following table, or where called for, a flexible cylindrical mandrel having an outside diameter 1/4-inch less than the inside diameter of the conduit. Only nylon cable (no rope) that will withstand a reasonable stress shall be used to pull the mandrel through the conduit system.

Conduit Size	Wire Size or Mandrel
2 inch	3 - 250 kcmil
3 inch and larger	Mandrel

3.3 INSTALLATION OF CONCRETE HANDHOLES, AND BOXES:

A. Elevation: Set all handholes so that the top of the handhole remains 1 inch above the surrounding finished grade. Where indicated cast handhole cover directly into roof of handhole.

B. Drainage: Install drains in bottom of units as shown on plans. Handhole drains shall be installed so that they drain water away from the handhole in which they are installed. The handhole installer shall contact the Engineer prior to installing the handhole drains and discuss options as to the best way to direct the water away from each particular handhole. The handhole installer shall receive the Engineer's approval for the method determined to be used prior to installing each handhole. In areas of high ground water or at the discretion of the engineer, a handhole drain shall be installed and extended and terminated at nearest catchbasin, culvert or gutter located downgrade from base of handhole.

C. Treatment of Castings, Frames and Fittings: All castings, frames, and fittings shall be placed in the positions indicated on the plans or as directed by the Engineer, and shall be set true to line and to correct elevation.

3.4 GROUNDING:

A. Ground underground ducts and utility structures (handholes) according to CSI Division 26 Section 260526, "Grounding and Bonding for Electrical Systems."

3.5 EXCAVATION AND BACKFILL:

A. The trench shall be backfilled in at least two layers with excavated material not larger than 4 inches in diameter and thoroughly tamped and compacted to at least the density of the surrounding undisturbed soil. If necessary to obtain the desired compaction, the backfill material shall be moistened or aerated as required.

B. Where trenching occurs in riprap or crushed stone areas, the surface material shall be replaced in kind. Where trenching in paved areas, the trench shall be sawcut and backfilled to the depth of the surface required to replace the removed pavement structure, which shall then be replaced. The edges of all trenches in paved surfaces shall be sawcut to neat lines prior to repaving.

C. Trenches shall not be excessively wet and shall not contain pools of water during backfilling operations.

D. The trench shall be completely backfilled and tamped level with the adjacent surface: except that, when sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

E. Any excess excavated material shall be removed and disposed of in accordance with instructions issued by the Engineer.

F. For Ducts without concrete envelope, 8 inches of sand, soft earth, or other fine fill (loose measurement) shall be placed around the ducts and carefully tamped around and over them with hand tampers. The remaining trench may be filled with regular run of excavated material and thoroughly tamped as specified above.

G. Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the trenching, storing of dirt, cable laying, pad construction and other work shall be restored to its original condition. The restoration shall include any necessary topsoiling, fertilizing, liming, seeding, sprigging, or mulching. The Installer shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance.

3.6 FIELD QUALITY CONTROL:

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in CSI Division 26 Section 260526, "Grounding and Bonding for Electrical Systems".

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.7 CLEANING:

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces handholes, including sump. Remove foreign material

END OF SECTION 260543

SECTION 260544 – SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Sleeves for raceways and cables.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicon Sealants.

1.2 DEFINITIONS:

A. EPDM: Ethylene-Propylene-Diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR SUBMITTALS.

B. Product Data: For sleeve seals and silicon sealants.

C. Quality Assurance Submittals:

1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.4 COORDINATION:

A. Coordinate sleeve selection and application with selection and application of firestopping specified in CSI Division 07 Section 078413, "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES:

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Conduits penetrating Non-Fire-Rated Gypsum Board Assemblies: galvanized-steel sheet, 0.0239 inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

D. Coordinate sleeve selection and application of firestopping specified in CSI Division 07 Section 078413, “Penetration Firestopping”.

2.2 SLEEVE-SEAL SYSTEM:

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements. Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: Interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Carbon steel (Composite material for the Salt Shed). Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel (stainless steel for the Salt Shed) of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 SLEEVE-SEAL FITTINGS:

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements. Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Presealed Systems.

2.4 GROUT:

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 SILICONE SEALANTS:

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2. Sealant shall have VOC content of 43 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR RACEWAYS AND CABLES:

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in CSI Division 07 Section, Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide ¼ annular clear space between sleeve and raceway unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

H. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in CSI Division 07 Section 078413, "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION:

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble

mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings

END OF SECTION 260544

SECTION 260548 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes vibration and seismic controls for surface conduit and electrical equipment.

B. Related Sections include the following:

1. CSI Division 26 Section 260529, "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.2 DEFINITIONS:

A. ICC-ES: ICC-Evaluation Service.

1.3 PERFORMANCE REQUIREMENTS:

A. Seismic-Restraint Loading: (see Drawing No. S-002).
1. Site Class as Defined in the IBC
2. Assigned Seismic Use Group or Building Category as Defined in the IBC
a. Seismic Design Category

3. Design Spectral Response Acceleration at Short Periods (0.2 Second)(S_{DS})
4. Design Spectral Response Acceleration at 1.0-Second Period S_{DI}

1.4 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service

member of ICC-ES or an agency acceptable to authorities having jurisdiction.

b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

C. Delegated-Design Submittal: For vibration isolation and seismic-restraint details 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. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.

a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other CSI Division 26 Sections for equipment mounted outdoors.

2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

D. Quality Assurance Submittals:

1. Welding certificates.
2. Qualification Data: For professional engineer and testing agency.

E. Field quality-control test reports.

1.5 QUALITY ASSURANCE:

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.

B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene, rubber, or hermetically sealed compressed fiberglass.

C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti Inc.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES:

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.

2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-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.

3.2 APPLICATIONS:

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION:

A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION:

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL:

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Engineer, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Engineer's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Engineer.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING:

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 ELECTRICAL VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE:

A. Supported or Suspended Equipment:

1. Equipment Location: Various.
2. Type: As required
3. Component Importance Factor: 1.5.

<u>Panelboards and Instrumentation Cabinets</u>

4. Component Response Modification Factor: 6.0.
5. Component Amplification Factor: 2.5.

Lighting and other Electrical Components

6. Component Response Modification Factor: 1.5.
7. Component Amplification Factor: 1.0.

Generator, Transformers, and Inverters

8. Component Response Modification Factor: 2.5.
9. Component Amplification Factor: 1.0.

END OF SECTION 260548

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 8187 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each electrical identification product indicated.

C. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels.

1.3 QUALITY ASSURANCE:

A. Comply with ASME A13.1.

B. Comply with NFPA 70.

C. Comply with ANSI Z535.4 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS:

A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

1. Color: Black letters on orange field.
2. Legend: Indicates voltage and service.

B. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

C. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.

1. Not less than 6 inches wide by 4 mils thick
2. Compounded for permanent direct-burial service.
3. Embedded continuous non-metallic strip or core.
4. Printed legend indicating type of underground line.

D. Wrap Around Cable Markers: Black, non-smear legends on white background with plastic coated cloth material which remains flexible. Strong adhesive shall assure firm bond on wire.

2.2 NAMEPLATES AND SIGNS:

A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.

1. Engraved legend with white letters on black face.
2. Punched or drilled for mechanical fasteners.

C. Exterior, reverse engraved and double laminated: Weather-resistant, nonfading, preprinted with colors, legend, and size required for the application.

D. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

E. Arc-Flash labels: Comply with requirements in CSI Section 260574, "Overcurrent Protection Device Arc-Flash Study." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.

F. Short-Circuit label(s): Comply with requirements in CSI Section 260572, "Overcurrent Protection Device Short-Circuit Study." Produce a thermal transfer label of high-adhesion polyester for each work location included in the analysis.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS:

A. Cable Ties: UL Listed, Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 18 lb minimum.
3. Temperature: 85 deg C.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install Raceways and Cable Labels per ASME.

B. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract or with those required by codes and standards. Use consistent designations throughout Project.

D. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

E. Conduit Labels: All intrinsically safe conduit systems including raceways, cable trays and junction boxes. Labels shall be applied per NEC 504.80.

F. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:

1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
2. Band Locations: At changes in direction, at penetrations of walls and floors, at 25-foot maximum intervals in straight runs, and at 10-foot maximum intervals in congested areas.
3. Apply the following colors to the systems listed below:

   a. Fire Alarm System: Red.
   b. Telecommunication: Green and yellow.
   c. Intrinsically Safe System: Light Blue.

G. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground metallic line marker located directly above line at 12 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker.

H. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system.

1. Color-code for 120/208 3 phase feeders as follows:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue. (applicable for 3 phase only)
d. Neutral: White.
e. Ground: Green.

I. Apply identification to conductors as follows:

1. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with circuit number.
2. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

J. Apply identification to junction boxes including voltage, circuit number, and phase of enclosed circuits.

K. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

L. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch- high lettering on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Panelboards, electrical cabinets, and enclosures.
2. Access doors and panels for concealed electrical items.
3. Emergency system boxes and enclosures.
4. Disconnect switches.
5. Enclosed circuit breakers.
6. Motor starters.
7. Push-button stations.
8. Contactors.
9. Control devices.
10. Power-generating units.

11. Telecommunications equipment.
12. Fire alarm system.
13. Main disconnect.

M. Each disconnect means shall be legibly marked to indicate its purpose. The marking shall be of sufficient durability to withstand the environment involved.

N. Exterior, reverse engraved and double laminated: Weather-resistant, nonfading, preprinted with colors, legend, and size required for the application. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Service entrance location. Mount sign to building adjacent to meter socket and main disconnect switch using appropriate concrete fasteners (ie stainless steel concrete screws, non-rusting concrete expansion anchor, non-rusting concrete lag shield anchor, non-rusting concrete metal hit anchor, or approved equal) Sign shall read "STAND-BY DIESEL GENERATOR UNIT LOCATED IN OUTDOOR ENCLOSURE ADJACENT TO BUILDING".

END OF SECTION 260553

SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.1 SUMMARY:

A. This section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.2 DEFINITIONS:

A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For computer software program to be used for studies.

C. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals and after feeder routing has been finalized and field verified. Submittals shall be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from the Engineer for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
b. Revised single-line diagram, reflecting field investigation results and

results of short-circuit study.

1.4 INFORMATIONAL SUBMITTALS:

A. Qualification Data: For Short-Circuit Study Specialist.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE:

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer and shall be stamped and signed by the professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the NETA or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE:

A. Software Developers: Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not limited to, the following:

1. ESA Inc.
2. Easy Power LLC;
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current- characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS:

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated fault-current magnitude and angle.
c. Fault-point X/R ratio.

d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. Calculated asymmetrical fault currents:

1) Based on fault-point X/R ratio.
2) Based on calculated symmetrical value multiplied by 1.6.
3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

2.3 SHORT-CIRCUIT WARNING LABELS:

A. Comply with requirements in CSI Section 260553 "Identification for Electrical Systems." Produce a thermal transfer label of high-adhesion polyester for service equipment location(s) included in the analysis.

B. The label shall include the maximum available fault current, the date the fault current calculation was performed, and shall comply with NEC Article 110.24.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of the Engineer.
2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals

for this Project.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY:

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on the plans.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.
2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources

throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.
2. Incoming switchgear.
3. Low-voltage switchgear.
4. Motor-control centers.
5. Control panels.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.
8. Disconnect switches.

3.3 ADJUSTING:

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

B. Branch circuit breakers shall not be adjusted below values indicated on drawings.

3.4 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 3 for additional information

B. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 260572

SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 SUMMARY:

A. This section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.2 DEFINITIONS:

A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For computer software program to be used for studies.

C. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals and after feeder routing has been finalized and field verified. Submittals shall be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from the Engineer for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.4 INFORMATIONAL SUBMITTALS:

A. Qualification Data: For Arc-Flash Study Specialist.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 CLOSEOUT SUBMITTALS:

A. Maintenance Data: Maintenance procedures according to requirements in NFPA 70E to include in operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE:

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer. Professional engineer shall sign and stamp all documentation.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the NETA or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS:

A. Software Developers: Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not

limited to, the following:

1. ESA Inc.
2. Easy Power, LLC
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENT:

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in Part 3.4, "Power System Data."

E. Short-Circuit Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.

6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS:

A. Comply with requirements in CSI Section 260553, "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 SHORT-CIRCUIT STUDY:

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.
2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Switchgear.
3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.

3.3 ARC-FLASH HAZARD ANALYSIS:

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Use the short-circuit study output and the field-verified settings of the overcurrent devices.

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources

are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.4 POWER SYSTEM DATA:

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Gather and tabulate the following input data to support coordination study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating and impedance.

6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
9. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
10. Motor horsepower and NEMA MG 1 code letter designation.
11. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
12. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.5 LABELING:

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:

1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Control panel.

3.6 APPLICATION OF WARNING LABELS:

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.7 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 3 for additional information

B. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc- flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260574

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following lighting control devices:

1. Outdoor photoelectric switches.
2. Indoor occupancy sensors.
3. Lighting contactors.
4. Emergency shunt relays.

B. Related CSI Sections include the following:

1. Division 26 Section 262726, "Wiring Devices" for wall manual light switches.
2. Division 26 Section 265119, "LED Interior Lighting".
3. Division 26 Section 265619, "LED Exterior Lighting".

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20 – 1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include dimensions and data on features, components, and ratings for lighting control devices.

1. Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.

D. Field quality-control test reports.

E. Maintenance Data: For lighting control devices to include in maintenance manuals specified in Form 818 Article 1.20 – 1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.3 QUALITY ASSURANCE:

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use and installation conditions by a testing agency acceptable to authorities having jurisdiction.

B. Obtain lighting control devices from a single source with total responsibility for compatibility of lighting control system components specified in this Section.

C. Comply with NFPA 70.

1.4 COORDINATION:

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

1.5 SEQUENCE OF OPERATIONS

A. Occupancy sensors shall initiate lighting operation in an area upon entry of one or more persons, and shall maintain uninterrupted lighting operation throughout the period that the area is occupied. In open areas, or areas with less than full height partitions, occupancy of portion of the area shall initiate operation of the lighting throughout the area, except where specifically directs otherwise.

B. When an area is vacated the lighting shall remain in operation for the adjustable time delay period.

C. The occupancy sensor coverage and sensitivity shall be adjusted so that an occupant in portion of a controlled room moving a hand in plane at approximately one (1) foot per second will trigger at least one occupancy sensor.

D. Lighting switch shall override the occupancy sensor when lighting switch is placed in the "off" position for area lighting that is also controlled by occupancy sensor.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Watt Stopper (The).

2. Leviton Mfg. Company Inc.
3. Lithonia Lighting; Acuity Lighting Group, Inc.

B. General Description: The purpose of indoor occupancy sensors is control the "on/off" operation of specific lighting. The means of accomplishing this is through the installation of individual room lighting "occupancy sensors" to control the operation of the lighting.

C. Power Supply: External power supply shall be 120 VAC, 60 HZ, with the following characteristics:

1. Secondary output 24Vc, 100mA minimum.
2. Transformer and contact closure relay in single unit.

D. Relays:

1. Contacts: Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
2. Contact Ratings: 20-A ballast load at 120V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac.
3. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts for each detection zone to provide accessory functions specified.

E. Occupancy/Motion Sensors:
1. Sensing system shall incorporate a time-delay-before-off relay, adjustable from 5 to 20 minutes.
2. Occupancy sensors in the Wash bay shall be weather proof.
3. Occupancy sensors shall include a manual override to energize the lighting system upon failure of the occupancy sensor, or occupancy sensor design/installation shall provide for the lighting system to automatically remain in operation upon a failure of the occupancy sensor.
4. Outdoor motion sensors shall be rated and labeled for outdoor conditions and operations and impervious to the effects of ultraviolet rays.

2.2 LIGHTING CONTACTORS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Watt Stopper (The).
2. GE Industrial Systems; Total Lighting Control.
3. Lithonia Lighting; Acuity Lighting Group, Inc.

B. Description: Electrically operated and mechanically held, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current), LED drivers.
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
   a. Continuously hinged with provisions for a pad lock.
   b. NEMA 1 for interior dry locations
   c. NEMA 4X stainless steel for wet and corrosive locations (ie. Salt shed and wash bay)
4. A “Hand”/“Auto” selector switch shall be included and installed on the interior of the enclosure in order to manually operate the contactor.

C. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in CSI Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

D. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 24 AWG. Comply with requirements in CSI Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

E. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in CSI Division 26 Section 260519, “Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION:

A. Install equipment level and plumb and according to manufacturer’s written instructions.

B. Mount lighting control devices according to manufacturer’s written instructions and requirements in CSI Division 26 Section 260529, “Hangers and Supports for Electrical Systems”.

C. Control Accessibility: Lighting controls must be within the room and readily accessible. This means visible and easily operated by the occupants of the space.

D. Minimum number of controls: At least one control must be provided for each 1500 watts of connected lighting within office core area.

E. Mounting heights shall be as indicated on the plans.

F. Ultrasonic and Multi-technology (Infrared-ultrasonic) ceiling occupancy sensors shall be installed at least 6 ft. away from HVAC supply/return vents.

G. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION:

A. Mount mechanically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION:

A. Wiring Method: Comply with CSI Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables." and CSI Division 26 Section 260533, “Raceway and Boxes for Electrical Systems”.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. Ground equipment.

3.4 IDENTIFICATION:

A. Identify components and power and control wiring according to CSI Division 26 Section 260533, "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label contactors with a unique designation.

3.5 FIELD QUALITY CONTROL:

A. Schedule visual and mechanical inspections and electrical tests with a least seven calendar days’ advance.

B. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer’s written instructions:

1. Continuity tests of circuits.
2. Operational Tests: Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions. Note: Due to room conditions it may be necessary for the Contractor to make adjustments, change the location or type of sensor to obtain proper operation and coverage of the system in each room and should therefore make labor allowance for such changes and adjustments.

    a. Include testing of devices under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.

C. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.

D. Lighting control devices that fail tests and inspections are defective work.

E. Test labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

F. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.6 CLEANING:

A. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damage finishes.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V and less.

B. Related CSI Sections include the following:

1. Division 26 Section 260553, "Identification for Electrical Systems" for labeling materials.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20 – 1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of panelboard, accessory item, and component specified.

1. Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: For panelboards. Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:

1. Enclosure type with details for types NEMA 250, Type 1 and others.
2. Bus configuration and current ratings.
3. Short-circuit current rating of panelboard.
4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
5. Wiring Diagrams: Details of schematic diagram including control wiring and differentiating between manufacturer-installed and field-installed wiring.
6. Panelboard Schedule: For installation in panelboards. Submit final versions after load balancing.

D. Quality Assurance Submittals:

1. Qualification Data: For firms and persons specified in Part 1.4, “Quality Assurance.”
2. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.3 QUALITY ASSURANCE:

A. Testing Agency Qualifications: Independent agency company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.4 COORDINATION:

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in CSI Division 03.

1.5 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels described contents.

1. Keys: 6 of each type for new panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Eaton Corp.; Westinghouse & Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Div.
3. Siemens Energy & Automation, Inc.
4. Square D Co.

2.2 PANELBOARD FABRICATION:

A. Enclosures: Flush- or surface-mounted cabinets as indicated. NEMA PB 1, Type 1, unless otherwise indicated to meet environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Other Damp Indoor Locations: NEMA 250, Type 4.
3. Other Wet Indoor Locations (i.e. Wash bay): NEMA 250, 4X
4. Other Corrosive Locations (i.e. Salt Shed): NEMA 250, 4X

B. Directory Frame: Metal, mounted inside each panelboard door.

C. Bus: Hard drawn copper of 98 percent conductivity. All panelboard's bus shall be copper including the main service disconnects.

D. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.

E. All main circuit breakers and branch circuit breakers shall be sized as indicated on the plans.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS:

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: In panelboard front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.

2.4 DISTRIBUTION PANELBOARDS:

A. Doors: In panelboard front, except omit in fusible-switch panelboard, unless otherwise indicated. Secure door with vault-type latch with tumbler lock, all keyed alike.

B. Branch-Circuit Breakers: Where overcurrent protective devices are indicated to be circuit breakers, use bolt-on circuit breakers, except circuit breakers above 225-A frame size may be plug-in type where individual positive-locking device requires mechanical release for removal.

2.5 OVERCURRENT PROTECTIVE DEVICES:

A. Molded-Case Circuit Breaker: NEMA AB 1, handle lockable.

1. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.
2. Application Listing: Appropriate for application, including Type SWD for switching fluorescent lighting loads and Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.
4. Circuit Breakers, 400 A and Larger: Field-adjustable short-time and continuous current settings.
5. Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.
6. Current Limiters: Where indicated, integral fuse listed for circuit breaker.
7. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

B. Fusible Switch: NEMA KS 1, Type HD, clips to accommodate specified fuses, handle lockable.

2.6 ACCESSORY COMPONENTS AND FEATURES:

A. Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: Arranged to permit testing of functions of solid-state trip devices without removal from panelboard.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install panelboards and accessory items according to NEMA PB 1.1.

B. Mounting Heights: Center of panelboard shall be at 48 inches above finished floor, unless otherwise indicated.

C. Mounting: Plumb and rigid without distortion of box. Mount flush panelboards uniformly flush with wall finish.

D. Circuit Directory: Type directory to indicate installed circuit loads after balancing panelboard loads. Provide a typed directory for both new and modified existing panelboards. Obtain approval before installing.

E. Install filler plates in unused spaces.

F. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

G. Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION:

A. Identify field-installed wiring and components and provide warning signs as specified in CSI Division 26 Section 260553, "Identification for Electrical Systems."

B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws.

3.3 GROUNDING:

A. Make equipment grounding connections for panelboards as specified in CSI Division 26, Section 260526, "Grounding and Bonding for Electrical Systems."

3.4 CONNECTIONS:

A. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL:

A. Testing Agency: Engage a qualified independent testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Prepare for acceptance tests as follows:

1. Test insulation-resistance tests of each panelboard bus, main circuit breaker, and branch circuit breakers, component, connecting supply, feeder, and control circuits.
2. Test continuity tests of each circuit.

D. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers or per manufacturer's written testing instructions. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, perform an infrared scan of each panelboard. Remove front panel so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard after the semi-final inspection.
c. Instruments and Equipment:
1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports; including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

G. Balancing Loads: Contractor shall maintain 20 percent between phase loads within each panelboard during installation, or maintain panel layout according to plans.

3.6 CLEANING:

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION 262416

SECTION 262419 – MOTOR-CONTROL CENTERS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section specifies furnishing and installing individually mounted motor starters and motor starters provided as components of equipment specified under other sections of these specifications. This section includes ac motor-control devices rated 600 V and less that are supplied as enclosed units.

B. Related CSI Sections include the following:

1. Division 26 Section 260553, "Identification for Electrical Systems" for labeling materials.
2. Division 26 Section 262813, "Fuses."

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For products specified in this Section. Include dimensions, ratings, and data on features and components.

1. Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: For motor controllers in accordance with NEMA Standards ICS for Class II, Type “B” construction, including interconnection wiring diagrams.

D. Qualification Data: For qualified testing agency.

E. Source quality-control reports.

1.3 QUALITY ASSURANCE:

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain MCCs and controllers of a single type from single source from single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.4 COORDINATION:

A. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.

B. Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.

C. Coordinate motor starters and combination motor starters with the provider or mechanical equipment. Some mechanical equipment is already supplied with starters and combination motor starters by the manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers (no equals): Subject to compliance with requirements, manufacturers offering products that shall be incorporated in the work are the following.

1. Eaton Corp.; Westinghouse & Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Div.
3. Siemens Energy & Automation, Inc.
4. Square D Co.

2.2 GENERAL:

A. Construct all products of the same type, size, rating and functional characteristics to be interchangeable and identically wired (sequence wiring).

B. Nameplates:

1. Provide a nameplate on each motor starter in accordance with NEMA ICS showing manufacturer's name and brand designation, reference standard, type class and rating as applicable.

2.3 SINGLE PHASE MOTOR CONTROLLERS:

A. Manual Starter with Thermal Protection and Pilot Light: Provide quick-make, quick-break, toggle switch type, with thermal type melting alloy overload protection. Use manual motor starters for single-phase motors rated less than 1/2 horsepower.

B. Manual Starter with Pilot Light: Provide quick-make, quick-break, toggle switch type. Use manual motor starters for single-phase motors rated less than 1/2 horsepower with integral thermal protection.

2.4 THREE PHASE MOTOR CONTROLLERS:

A. Combination Magnetic Controller: Full voltage, across-the-line, magnetic starter sized to conform with standard NEMA rating for the associated motor with fusible disconnect short circuit protection, for use on nominal 208 volt, three-phase, 60 Hertz service with control transformer for 120 volt control. Including:
   1. Overload protection in the form of: three thermal type ambient-compensated bimetallic strip overload relays selected on the basis of actual motor nameplate current.
   2. Convertible auxiliary contacts required for indicated control functions.
   3. Cover mounted “Hand-Off-Auto” selector switch.
   4. Cover mounted red and green LED pilot lights.
   5. Cover mounted start-stop pushbutton.
   6. Units shall include "Hand-Off-Auto" selector switch and pilot light in a single enclosure (all starter selector switches shall be key operated except for in the Electrical Room and Mechanical Room). Key shall be removable in all positions.

2.5 ENCLOSURES:

A. Enclosures: Select motor controller and switch enclosures suitable for the environment in which they are to be used:

   1. Enclosures for use indoors and in dry, dust free areas: NEMA Type1.
   2. Enclosures for outdoor locations or where moisture is present: Stainless steel NEMA Type 3R, type 4, or Type 4X, weatherproof enclosure, as indicated.
   3. Enclosures for areas where dust and dirt likely to be present: NEMA 12 industrial type.
   4. Enclosures for hazardous areas: Approved for specific hazardous location.
   5. Factory Finish: Degrease and provide phosphate coating, after fabrication, to surfaces which are to be painted. Apply undercoat of rust-resistant paint such as zinc chromate over the phosphate coating (except for stainless steel). Apply finish painting of baked on, ANSI 61 baked enamel.

2.6 ACCESSORIES:

A. Accessories: Provide special tools or other devices normally furnished or required for installation, care and maintenance of equipment.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install motor controllers according to manufacturer's written instructions.

B. Install conduit in accordance with CSI Division 26 Section 260533, “Raceway and Boxes for Electrical Systems.”

C. Connect power cable and control wire as recommended by manufacturers. Make power cable and control cable connections to manual starters, and across-the-line magnetic starters by means of integral mechanical connectors. If such items are not furnished with integral mechanical connectors, make connections using compression connectors in accordance with CSI Division 26 Section 260519, “Low-Voltage Electrical Power Conductors and Cables.”

D. Ground motor starter in accordance with CSI Division 26 Section 260526, “Grounding and Bonding for Electrical Systems.”

E. Apply touch up paint as necessary.

3.2 IDENTIFICATION:

A. Identify motor-control components and control wiring according to CSI Division 26 Section 260553, "Identification for Electrical Systems."

3.3 CONTROL WIRING INSTALLATION:

A. Install wiring between motor-control devices according to CSI Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices where available.

1. Connect selector switches to bypass only the manual and automatic control devices that have no safety functions when switch is in the hand position.

2. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.4 CONNECTIONS:

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL:

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Inspection and Tests: In addition to any inspection and test requirements noted elsewhere, the following tests are required.

1. The equipment shall be fully assembled, wired and tested at the factory.
2. The motor controllers shall be given visual inspection, wiring checks and operation, continuity, and electric tests for each circuit in accordance with the latest standards of IEEE, NEMA and ANSI, in order to assure completeness, adequacy, and proper functioning equipment. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.
3. Where more than one test is indicated in test code, state by which method the test will be performed.
4. All tests shall be performed in the presence of the Engineer. The Engineer shall be permitted to inspect any equipment, material or work to be furnished under these specifications and shall have the right to reject any parts considered defective or unsuitable for the use and purpose intended or not in accordance with these specifications.
5. After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements. Remove and replace malfunctioning units with new units, and retest.

3.6 CLEANING:

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

END OF SECTION 262419

SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL.

1.1 SUMMARY:

A. This Section includes electricity-metering components and coordination with electrical utilities.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR SUBMITTALS.

B. Shop Drawings for Electricity-Metering Equipment:

1. Dimensioned plans and sections or elevation layouts.
2. Wiring Diagrams: Power, signal, and control wiring specific to this Project. Identify terminals and wiring designations and color codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.
3. Mounting and anchoring devices recommended by manufacturer to resist seismic forces.

C. Test and Inspection reports performed by an independent agency.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: Independent agency company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain main disconnect switch, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for main disconnect switch including clearances between main disconnect switch and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Receive, store, and handle modular meter center as specified in NECA 400.

1.5 COORDINATION:

A. Coordinate electrical service connections to components furnished by utility companies.

1. Coordinate installation and connection of exterior underground utilities and services, including provision for electricity-metering components.
2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
3. Coordinate the installation of new service by minimizing the power outage to the existing service.

B. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

C. Electrical Service for Maintenance Building: Eversource shall provide and install pole mounted transformers on exiting Pole #1257. The pole mounted utility transformer shall be rated 120/208 volts, 3 phase, 400A. There is an Eversource utility charge for installation and connection of primary cable from existing utility pole to proposed utility pole and new pole mounted transformer. Location of the proposed pole mounted transformers are as indicated on the plans or as determined by the utility company. All the conduits and pull strings, grounding, new meter socket and associated conduit shall be supplied and installed by the Contractor. The utility company shall supply the meter and secondary conductors to the meter socket.

D. Electrical Service for Repair/Stores Building: Primary electric service cables and 120/208 volts, 3 phase, 600A transformer shall be furnished and installed by Eversource. There is an Eversource utility charge for installation and connection of primary cable from existing utility pole to new pad mounted transformer. Location of the transformer is indicated on the plans or as determined by the utility company. All the conduits, pull strings, transformer pad, grounding, secondary service conductors, and meter socket shall be supplied and installed by the Contractor. The utility company shall supply the meter, CT's, test switch, and metering conductors.

E. Utility work includes the disconnection and removal of the existing 3 phase service to the Repair/Maintenace building and salt shed.

F. The Eversource charge of $11600 shall be included in the contract bid price. This amount includes the service connections to the facilities and utility work in as noted in the sections above.

G. All bidders will include the above amount in Item No. 1700001A – Service Connections (Estimated Cost) along with costs for work by other utilities.

H. The Contractor shall call “Call Before You Dig!” at 811 or (800) 922-4455, before any excavation takes place. Contractor shall coordinate excavation with paving operation.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING :

A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.

B. Meter Sockets: Comply with requirements of electrical power utility company.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.

   a. Cutler-Hammer; Eaton Corporation.
   b. General Electric Company; Electrical Distribution & Control Div.
   c. Siemens Energy & Automation, Inc.
   d. Square D; Schneider Electric.

2. Housing: NEMA 250, Type 1 or 3R enclosure, depending on the location.

   a. Structural strength of the housing, its anchorage and component attachment provisions, and anchorage devices recommended for anchoring the housing in place shall be adequate to prevent separation of equipment and its components from their installed positions.

   b. Identification: Complying with CSI Division 26 Section 260553, "Identification for Electrical Systems."
   c. Physical Protection: Tamper resistant, with hasp for padlock.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION:

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION:

A. All enclosures shall comply with Section 260533 "Raceways and Boxes for Electrical Systems".

B. Support clamps shall comply with Section 260529 "Hangers and Supports for Electrical Systems".

3.3 SUPPORT INSTALLATION:

A. Supports shall comply with Section 260529 "Hangers and Supports for Electrical Systems".

3.4 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT:

A. Install equipment according to utility company's written requirements. Provide grounding, empty conduits, and pullwire as required by utility company. Contractor shall only run conduit under slab of building for conduits penetrating the building and routed from the outside. Conduits within the building shall not be run in slab unless otherwise indicated.

B. Metering enclosure per Electric Utilities' specifications. The meter is to be located outside the building wall within 50 feet of the main switch.

C. All service entrance equipment including the appropriate size and type of conduit and service entrance conductors per the NEC and local authority having jurisdiction.

3.5 FIELD QUALITY CONTROL:

A. Testing Agency: Engage a qualified independent testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Prepare for acceptance tests as follows:

1. Test insulation-resistance tests of main switch disconnect, main circuit breaker, component, connecting supply, feeder, and control circuits.
2. Test continuity tests of each circuit.

D. Testing: After installing main switch disconnect and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers or per manufacturer's written testing instructions. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, perform an infrared scan of each main switch disconnect. Remove front panel so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each main switch disconnect after the semi-final inspection.
c. Instruments and Equipment:
1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

E. Main Disconnect Switch will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies Main Disconnect Switch included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 CLEANING:

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION 262713

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes the following:

1. Receptacles
2. Ground Fault Circuit Interrupter Receptacles
3. Plugs
4. Toggle Switches
5. Wave Switches
6. Wall Plates
7. Cord Reels
8. Door Strike
9. Intercom System

B. Related CSI Sections include the following:

1. Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables"
2. Division 26 Section 260533, "Raceway and Boxes for Electrical Systems"

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20 – 1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For all wiring devices.

1.3 QUALITY ASSURANCE:

A. Comply with NFPA 70.

B. UL and NEMA Compliance: Provide wiring devices and call to aid equipment which are listed and labeled by UL and comply with applicable UL and NEMA standards.

1.4 SEQUENCE AND SCHEDULING:

A. Schedule installation of finish plates after the surface upon which they are installed has received final finish.

PART 2 - PRODUCTS

2.1 WIRING DEVICES:

A. General: Provide specification grade wiring devices, in types, characteristics, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards.

1. General: Wiring devices include receptacles, switches and special outlets installed in raceway or conduit boxes, complete with cover plates. Devices shall conform to NEMA WD-1 and shall be UL approved.
2. All devices of a given type and all finished device plates shall be the products of a single manufacturer.
3. Plugs of types to match the associated receptacle shall be provided with each item of portable equipment as specified in other sections. In addition, are spare plugs to match each special receptacle as herein after specified shall be furnished.

B. Enclosures: NEMA Type 1 for the Office Facility or as indicated on plans. NEMA Type 4X for the salt shed or as indicated on plans. PVC coated boxes, cabinets, and fittings, approved for use with PVC coated conduit (Permacote or equal).

C. Switches:

1. AC tumbler-toggle switches: Meeting minimum requirements of UL 20 and further requirements herein specified and of specification grade, heavy duty, of the type indicated on the plans. Switches shall be gray in color.

a. Provide switches that operate in any position and are fully enclosed cup type with entire body and cover of molded phenolic, urea or melamine. Do not use fiber, paper or similar insulating material for body or cover.
b. Equip switches with metal mounting yoke with plaster ears, insulating from the mechanism and fastened to the switch body by bolts, screws, rivets or other substantial means that meet test requirements.
c. Provide a green-colored equipment grounding screw on the yoke.
d. Provide the section of yoke normally intended to bear on the surface outside the box with a minimum overall dimension of 3/4 inch, measured at right angles to the longitudinal axis of the yoke.
e. Make switch contacts between silver or silver alloys.
f. Switches shall be side wired with terminal of screw or combination screw-clamp type. Provide access holes for back wiring.
g. Wiring terminals capable of receiving and holding proper wire sizes as shown below:

Switch Rating	Wire Size, AWG No.
20 amperes	12

30 amperes	10

2. Switches for Use on Lighting Circuits: Fully rated 20 or 30 amperes at 120 or 208 volts, as indicated on the plans. Actual connected lamp wattage not to exceed the following:

Switch Rating at 120 and 208 Volts	Maximum Wattage Allowed
20 amperes	1,400
30 amperes	2,400

3. Wave Switch: hands-free technology that allows you to turn lights/devices on and off with a wave of your hand. Legrand Adorn wave switch or approved equal.
4. Switches for Power Equipment: Switches controlling outlets other than lighting, such as motors less than 1/4 horsepower may be specification grade, flush type, AC/DC contacts rated ten amperes, 120/208 Volts. Switches controlling straight resistance loads may be snap switches as specified herein, of the proper rating up to 30 amperes at 120-208 volts. Switches used for controlling motors shall be rated for at least the horsepower of the motor controlled.
5. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

   a. Arrow-Hart Division, Crouse-Hinds Company.
   b. Hubbell, Inc.
   c. Legrand
   d. General Electric.

D. Receptacles and Plugs:

1. General Use: Grounding duplex type, conforming to NEMA WD-1, configuration 5-20R. Bodies shall be of thermosetting plastic supported on a metal mounting strap. Wiring terminals shall be of the screw type, side wired. Receptacles shall be gray in color.
2. Ground Fault Interrupter Receptacle: NEMA Designation 5-20R, duplex, three wire, 20 amperes, 125 volt, ground fault interrupter type with pilot light to indicate if receptacle is working or faulted (tripped). Do not arrange to protect connected downstream receptacles on same circuit unless called for on plans or approved by Designer. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.
3. Power Washer Plug/Receptacle: Watertight 250V, three phase, 30 amperes, 3-pole, 4 wire grounding NEMA Configuration L17-30R. Example part number Hubbell: HBL2740SW.
4. Twistlock receptacles for lighting in the Bay Areas. NEMA Designation L5-20R, 2 pole, three wire, 20 amperes, 125 volt. Twistlock receptacle for Bay Areas emergency Lighting. NEMA Designation L14-20R, 3 pole, four wire, 20 amperes,

125/250 volt. Receptacle shall be supplied with the matching plug. Provide Watertight twistlock receptacles in the Wash Bay.

5. Stove Receptacle: 240V, single phase 50 amperes, two pole, four wire, grounding type NEMA configuration L14-50, or type as specified by stove manufacturer.
6. Available Manufacturers: Subject to compliance with requirements, manufacturers of other devices offering products which may be incorporated in the work include, but are not limited to, the following:

    a. Arrow-Hart Division, Crouse-Hinds Company.
    b. Square D Company.
    c. Harvey Hubbell, Inc.

E. Cord Reels:
1. Industrial grade, configuration 5-20R, 50 ft. length, 125V AC, Cable type 12/3 SOW-A, 20 amps, 1-phase.

F. Device Plates:

1. All device plates shall be 0.040 inch minimum with struck-up beveled edges, void of sharp corners and burrs.
2. Unless otherwise noted herein and on drawings, all device plates for wall outlets and switches shall be brush satin finish stainless steel for office areas and bay areas.
3. Device plates for wall telephone outlets shall contain two openings for RJ45 Jacks. One Jack for voice and the other for data. Wall outlets shall be brush satin finish stainless steel for office areas and bay areas.
4. Device plates for exposed work shall be steel. Plates for wet locations and those installed in the Salt Shed shall be gasketed and shall have in-use type extra-duty covers. In-use type covers shall be metallic for non-corrosive areas.
5. Plate-Securing Screws: Metal with head color to match plate finish.
6. PVC weatherproof toggle switch covers (Carlon or approved equal) shall be provided for all switches within the salt shed and Washbay.

G. Intercom System:
1. Door station: AIPHONE IX-DVF or approved equal
    a. Stainless steel
    b. Flush mounted
2. Master Station: AIPHONE IX-MV-7HB or approved equal
    a. 7” touchscreen, audio/video station, paging, transfer, door release.
    b. Wired System, PoE/PoE+ network switch
    c. Door release button
3. Power Supply and Wire: As specified by the manufacturer.

H. Door Strike:

1. Stainless steel single gang mounted push button.

2. Door strike shall be compatible with the door. Doorstrike shall be constructed of stainless steel
3. Door strike shall be fire rated when installed in fire rated doors/walls.
4. Door strike shall be compatible with Door release controls

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES AND ACCESSORIES:

A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other Work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other Work.

C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

D. Protect devices and assemblies during painting. Install wall plates after painting work is completed.

E. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A. Use properly scaled torque indicating hand tool.

F. Switches and Receptacles: Unless otherwise indicated, mount flush, with long dimension vertical. Wall switches shall be mounted opposite hinge side of door, 4” from door trim, and ganged under one cover where more than one switch is shown. See mounting height detail for mounting heights of the electrical apparatus.

3.2 PROTECTION:

A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.3 FIELD QUALITY CONTROL:

A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to

energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.

B. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

C. Remove malfunctioning units, replace with new units, and retest as specified above.

3.4 CLEANING:

A. General: Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Fuses.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20 – 1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each fuse type specified. Include the following:

1. Descriptive data and time-current curves.
2. Let-through current curves for fuses with current-limiting characteristics.
3. Coordination charts and tables and related data.
4. Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

1.3 QUALITY ASSURANCE:

A. Source Limitations: Obtain fuses from one source and by a single manufacturer.

B. Comply with NFPA 70 for components and installation.

C. Listing and Labeling: Provide fuses specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the NEC, Article 100.

1.4 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Spare Fuses: Furnish quantity equal to 20 percent of each fuse type and size installed, but not less than 1 set of 3 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fuses that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries, Inc.; Bussmann Div.
2. Eagle Electric Mfg. Co., Inc.
3. Edison Fuse, Inc.
4. General Electric Co.; Wiring Devices Div.

2.2 CARTRIDGE FUSES:

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class as specified or indicated; current rating as indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS:

A. Main Service: Class L, fast acting.

B. Main Feeders up to 600A: Class J, time delay.

C. Motor Branch Circuits: Class RK1, RK5 time delay.

D. Other Branch Circuits: Class RK1, RK5 non-time delay.

3.3 INSTALLATION:

A. Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.

3.4 IDENTIFICATION:

A. Install labels complying with requirements for identification specified in CSI Division 26, Section 260553 "Identification for Electrical Systems" and indicate fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes individually mounted switches and circuit breakers used for the following:

1. Service disconnect switches
2. Feeder and equipment disconnect switches
3. Feeder branch-circuit protection
4. Motor disconnect switches
5. Bolt-on circuit breakers

B. Related CSI Sections: The following Sections contain requirements that relate to this section:

1. Division 26 Section 260533, "Raceways and Boxes for Electrical Systems".
2. Division 26 Section 262419, "Motor-control Centers".
3. Division 26 Section 262726, "Wiring Devices" for attachment plugs and receptacles, and snap switches used for disconnect switches.
4. Division 26 Section 262813, "Fuses".

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20 – 1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data for switches, circuit breakers, and accessories specified in this Section. Include the following:

1. Descriptive data and time-current curves.
2. Let-through current curves for circuit breakers with current-limiting characteristics.
3. Coordination charts and tables and related data.
4. Wiring diagrams detailing wiring for power and control systems and differentiating between manufacturer-installed and field-installed wiring.
5. Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Quality Assurance Submittals:

1. Qualification data for firms and persons specified in Part 1.3 "Quality Assurance" to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Test and Inspection reports performed by an independent agency.

1.3 QUALITY ASSURANCE:

A. Testing Agency Qualifications: The independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of NETA.

1. Testing Agency's Field Supervisor: Person currently certified by NETA or the NICET, to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain disconnect switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from one source and by a single manufacturer.

C. Comply with NFPA 70 for components and installation.

D. Listing and Labeling: Provide disconnect switches and circuit breakers specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the NEC, Article 100.

1.4 COORDINATION:

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate installation of new circuit breakers in existing panels. Match existing panel KIC rating and manufacture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering disconnect switches and circuit breakers that may be incorporated into the Work include, but are not limited to, the following:

1. Fusible Switches:

   a. Eaton Corp.; Cutler-Hammer Products
   b. General Electric Co.; Electrical Distribution and Control Division
   c. Siemens Energy & Automation, Inc.
   d. Square D Co.

2. Molded-Case Circuit Breakers:

   a. Eaton Corp.; Cutler-Hammer Products
   b. General Electric Co.; Electrical Distribution and Control Division
   c. Siemens Energy & Automation, Inc.
   d. Square D Co.

3. Combination Circuit Breaker and Ground Fault Trip:
   a. General Electric Co.; Electrical Distribution and Control Division
   b. Siemens Energy & Automation, Inc.
   c. Square D Co.

4. Molded-Case, Current-Limiting Circuit Breakers:

   a. General Electric Co.; Electrical Distribution and Control Division
   b. Siemens Energy & Automation, Inc.
   c. Square D Co.

5. Integrally Fused, Molded-Case Circuit Breakers

   a. General Electric Co.; Electrical Distribution and Control Division
   b. Siemens Energy & Automation, Inc.
   c. Westinghouse Electric Corp.; Distribution & Control Business Unit.

6. Bolt-on circuit breakers

   a. General Electric Co.
   b. Square D Co.

2.2 DISCONNECT SWITCHES:

A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position.

C. Enclosure: NEMA KS 1, Type 1, unless otherwise specified or required to meet environmental conditions of the installed location.

1. Outdoor Locations: Type 3R.
2. Wash Bay: Type 4X, stainless steel.
3. Corrosive Location (i.e, Salt Shed, etc): Type 4X, stainless steel.
4. Damp Indoor Locations: Type 4.

2.3 ENCLOSED CIRCUIT BREAKERS:

A. Enclosed, Molded-Case Circuit Breaker: NEMA AB 1, with lockable handle.

B. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting rating to meet available fault current.

C. Application Listing: Appropriate for application, including switching fluorescent lighting loads or heating, air-conditioning, and refrigerating equipment.

D. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.

E. Circuit Breakers, 400 A and Larger: Field-adjustable, short-time and continuous-current settings.

F. Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.

G. Current Limiters: Where indicated, integral fuse listed for circuit breaker.

H. Molded-Case Switch: Where indicated, molded-case circuit breaker without trip units.

I. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

J. Shunt Trip: Where indicated.

K. Accessories: As indicated.

L. Enclosure: NEMA AB 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.

1. Outdoor Locations: Type 3R.
2. Wash Bay: Type 4X, stainless steel.
3. Corrosive Location (i.e, Salt Shed, etc): Type 4X, stainless steel.
4. Damp Indoor Locations: Type 4.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install disconnect switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.

B. Install disconnect switches and circuit breakers level and plumb.

C. Connect disconnect switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Identify each disconnect switch and circuit breaker according to requirements specified in CSI Division 26 Section 260553, "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL:

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Testing: After installing disconnect switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for disconnect switches and Section 7.6 for molded-case circuit breakers or per manufacturer's requirements. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panel so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker after the semi-final inspection.
    c. Instruments and Equipment:
4. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device

E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.3 CLEANING:

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION 262816

SECTION 263213 – ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY:

A. The Installer shall design, engineer, furnish, deliver, and install one exterior diesel engine generator set with all necessary accessories and auxiliary equipment for use on the services as hereinafter described.

B. The diesel generator set manufacturer shall also:

1. Conduct a program of its standard factory tests to verify system performance in accordance with this Section.
2. Provide erection and commissioning advisers and testing personnel to ensure operation of the diesel generator set as specified herein.

1.2 SYSTEM DESCRIPTION:

A. The diesel generators and auxiliaries shall be classified as a Type 10, Class 48, and Level 2 Standby Power Supply System in accordance with NFPA 110. The diesel generator sets and auxiliaries shall meet <u>all</u> NFPA 110 requirements, which apply to this classification.

B. The systems shall include a complete unit consisting of the engine, generator, basic accessories mounted on a rigid common base, double wall base fuel tank, enclosure, control panels, automatic voltage regulator, and necessary accessories, all comprising a complete package. It shall be completely assembled, piped, wired, and tested as a complete system at the factory. The factory testing shall consist of the manufacturer's standard program of tests as required by NEMA MG1. The complete system shall be in accordance with NEC Article 700 and NFPA 110.

C. The diesel generators and all other accessory equipment shall be of the latest design conforming to accepted manufacturers' standards for this equipment and shall be offered only for the rating and service for which they were designed. All equipment and material required for operation shall be furnished by the diesel generator manufacturer.

D. The Installer shall arrange with the manufacturer in writing, with a copy to the Engineer, for supervision by the manufacturer to insure proper installation of the equipment. This shall include as many site visits as necessary, but not less than three. The first site visit shall be made by the manufacturer before the diesel generator is set in place or connections roughed, and the second site visit shall be made by the manufacturer after the diesel generator is set in place but before connections are made. During visits, the manufacturer shall consult with the Engineer, the Installer, and all others providing work or connections to the standby generator. Failure to receive a

written request shall not relieve the manufacturer of his responsibility to supervise and visit the installation. Any changes or recommendations made during site visits shall be forwarded in writing to the Engineer.

E. Should the engine, the generator, or both, or associated parts be damaged in any way during construction, the complete diesel generator unit shall be removed from the site and replaced with a new diesel generator at the expense of the Installer without cost to others. Additional construction costs or other costs to the purchaser caused because of the engine-generator and ancillary equipment replacement shall be at the expense of the installer without cost to others. A temporary unit shall be provided if necessary in order not to delay completion of the Work.

F. Failure to receive a written request shall not relieve the manufacturer of his responsibility to supervise and visit the installation. Any changes or recommendations made during site visits shall be forwarded in writing to the Engineer.

1.3 APPLICABLE DOCUMENTS:

A. The latest issues of the following documents are in addition to those previously referenced. If there is, or seems to be, a conflict between this Section and a referenced document, the matter shall be referred to the Engineer.

ANSI/ABMA-9	Load Ratings and Fatigue Life for Ball Bearings
ANSI/ABMA-11	Load Ratings and Fatigue Life for Roller Bearings
ANSI B31.1	Power Piping Code
ANSI C37.20	Switchgear Assemblies, Including Metal Enclosed Bus with Supplement C37.20D
ANSI C50.10	General Requirements for Synchronous Machines
ANSI C50.12	Requirements for Salient Pole Synchronous Generation and Condensers
ANSI C57.13	Requirements, Terminology, and Test Code for Instrument Transformers
ANSI/ASA 47	Sound Level Meters
ANSI/ASA 53	Preferred Frequencies and Band Numbers for Acoustical Measurements
ANSI/ASA 6586	Octave, Half Octave, and Third Octave Band Filter Sets
IEEE Std 85	Test Procedures for Airborne Noise Measurement on Rotating Electric Machinery
IEEE 112	Standard Test Procedure for Polyphase Induction Motors and Generators
IEEE Std 115	Test Procedure for Synchronous Machines
NEMA MG1	Standards for Motors and Generators
NFPA 30	Flammable and Combustible Liquids Code
NFPA 37	Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 110	Emergency and Standby Power Systems

UL 80	Steel Inside Tanks for Burner Fuel
UL 2200	Generator

1.4 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.02.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data:

1. Generator capability curves.
2. Field forcing data to calculate sustained fault current.
3. Pertinent performance curves, which shall include the following:

   a. Electrical load starting capability curves, with time and voltage on the ordinate and starting kVA on the abscissa axis, showing the minimum value reached, the time it is reached, recovery value, and time to reach recovery value;
   b. The same curves stated above for frequency instead of voltage;
   c. Curves showing time to recover to 100 percent nominal voltage vs. starting kVA;
   d. Curves showing time to recover to 100 percent nominal frequency vs. starting kVA;
   e. A 'plot' or 'coordinate point listing' versus time, at 0.1" intervals, for 5" following each load application, shall be furnished for both voltage and frequency. One set of data based on the loading requirements delineated in Section 3.2.

C. Shop Drawings:

1. Assembly and shop detail drawings.
2. Field erection drawings, if required.
3. Outline drawings, including plans and elevations.
4. Electrical elementary and wiring diagrams. Wiring diagrams shall be of the continuous line type. All transfer switches shall be shown on one wiring drawing along with all conduits and wire sizes.
5. Schematic and piping diagrams.
6. Catalog cuts showing the general arrangement and approximate dimensions of the equipment proposed.
7. Typical cross-sectional catalog cuts, or other means of showing salient features of the equipment proposed.
8. Catalog cuts showing estimated weights and distribution of static, live, and other loads.
9. Sound Levels:

a. The manufacturer shall provide, with the shop drawings, the maximum octave band sound pressure levels and the maximum A-weighted sound level at 23 ft from the engine block, and at the outlet of the exhaust muffler with an average 8 measurements. The sound level shall be in accordance to the town where the generators are installed and the defined property line.

b. The Contractor shall submit the basis for which the sound level data is made. This may include certified test data from identical or similar equipment. All data should show conformance to proper test procedures, as detailed in IEEE 85, DEMA Test Code for the Measurement of Sound from heavy-duty Reciprocating Engines, and AMCA 300 Test Code for Sound Rating Air Moving Devices. Where measured data are not available, estimated values may be submitted for the Designers' evaluation if accompanied by a thorough explanation, including all assumptions made.

c. Sound pressure level data shall be measured in decibels, referenced to 2x10 Pascal's, using a sound level meter conforming to ANSI S1.4, Type 1, tolerance limits. All octave band filter sets shall conform to ANSI S1.11, Class II, Type E, and tolerance limits. The nine preferred octave bands, specified in ANSI S1.6, shall be used in submitting these data.

D. Operation and Maintenance Manuals: For generators, all installed devices associated, and components to include in the operational and maintenance manuals specified in Form 818 Article 1.20-1.08-14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1. All equipment shall be specifically identified, such as by serial number.
2. One set of instructions, certified by the manufacturer, shall be packed and sent with the equipment to the Project Site. A parts identification list shall accompany each set of instructions. This shall include sectional and/or outline prints or illustrations, identifying each numbered part and location in relation to the equipment as a whole.

1.5 QUALITY ASSURANCE:

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project Site.

a. The manufacturer, in addition, shall maintain a complete stock of genuine factory replacement parts necessary for a complete overhaul of the systems. Factory-trained service personnel shall be made available on a 24-hr basis. Availability of service and parts shall remain a direct function of the manufacturer and shall not be relegated to other service organizations.

2. Engineering Responsibility: Preparation of data for vibration isolators of engine skid mounts, including Shop Drawings, based on testing and engineering analysis

of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project Site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the NETA or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the NETA or the NICET to supervise on-site testing specified in Part 3.

D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with ASME B15.1.

G. Comply with NFPA 37.

H. Comply with NFPA 70.

I. Comply with NFPA 99.

J. Comply with NFPA 110 requirements for Level 2 stand-by power supply system.

K. Comply with UL 2200.

L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

M. Noise Emission: Noise levels shall consist of the average sound pressure measurements at eight evenly spaced locations 360^0 around the generator enclosure taken 23’ from the generator enclosure under full load. The following noise levels shall apply:

1. Generator in a sound attenuated enclosure, Average noise level at 23’ shall be no more than:
   a. Maintenance Facility Generator (130KW/162KVA): 76 db(A)
   b. Repair Facility Generator (60KW/75KVA): 76 db(A)

1.6 WARRANTIES:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. The standby generator systems shall be warranted by the manufacturer for 5 years or 3,000 hours, whichever occurs first, from the date of the issuance of the Certificate of Compliance. The vendor must be the authorized distributor of all major components and must provide documentation supporting their ability and authority to perform all warranty service and repairs. The warranty shall cover both parts and labor for the complete warranty period.

1.7 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted Quantities below are examples only.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
4. Keys: 6 spares of each type for generator enclosure.

1.8 COORDINATION:

A. The contractor shall fill the generator base tanks with motor vehicle diesel fuel as defined in Section 22a-174-42 of the Regulations of Connecticut State Agencies. A charge of $1,658 shall be included in the Contract Bid Price for the filling of the generator base tanks with Ultra Low Sulfur Diesel fuel for the site or as otherwise directed by the Engineer. If it is determined that different charges apply, the Contractor's bid will be adjusted to reflect the differential by construction order, provided that the Contractor provides all applicable written billing documentation. The Contractor will be compensated only for the difference between the billed amount and the estimated amount. No additional Contractor markup will be allowed.

a. Maintenance Facility Generator: 221 gallons of diesel required which approximately cost $553.00
b. Repair Facility Generator: 442 gallons of diesel required which approximately cost $1,105.00

B. All bidders will include the above amount for tank filling in Item No. 1600002A – Fuel Adjustment Cost along with costs for work other fuels.

PART 2 - PRODUCTS

2.1 DIESEL GENERATOR UNITS:

A. Manufacturers (no equals): Subject to compliance with requirements, manufacturers offering products that shall be incorporated in the work are the following.

1. Cummins Power Systems.
2. Kohler Power Systems.
3. Caterpillar.
4. MTU Onsite Energy (Atlantic Power Systems)
5. Generac

B. Responsibility: The diesel generator units shall be the standard product of a firm regularly engaged in the manufacture or assembly of generating sets. Either the generator or engine manufacturer or their authorized distributor shall provide the diesel generator units. The engine-generator units shall be assembled and tested at the manufacturer's facility prior to shipment to the Project Site. The diesel generator sets manufacturer shall be fully responsible to the Installer and Owner for the successful operation of the entire standby generator units and shall use only proven standard packaged units.

C. Conditions of Service:

1. The diesel generator units will be required to operate in case of complete loss of utility power, to supply power to 100% of the load until normal power is returned. It will also be periodically started and test run and loaded to assure that the units are maintained in good operating condition.
2. Two separate units will be used to supply emergency power to two separate facilities. A maintenance facility on a 208Y/120 VAC 3 phase, 60 Hz, 4 wire and a Repair Facility on a 208Y/120 VAC 3 phase, 60 Hz, 4 wire, grounded commercial power system.
3. The diesel generator units shall be capable of starting cold in a minimum outdoor ambient of -20°F, accelerating to rated speed, frequency, and full voltage and ready to accept load to its rated capacity in not more than 10 seconds from system start signal, and shall also be capable of carrying continuously rated load in a maximum outdoor ambient of 105°F. The diesel generator units shall be capable of carrying rated load with the outside combustion and cooling air temperature ranging from -20°F to 105°F with a maximum relative humidity of 100 percent. The electrical components and transfer switch shall be capable of functioning properly when exposed to these outside ambient conditions with such cooling air conditions. The Installer shall coordinate interfaces with others as required.

D. Performance Required:

1. The diesel generator sets shall be rated continuous standby, Voltage and Phase as indicated on drawings, 0.8- lagging power factor, minimum rated size as shown on the plans at the environmental conditions stated herein.
2. The diesel generators shall be capable of starting either manually or automatically and, in either case, transferring to previously energized or de-energized loads.
3. Upon receiving a start signal from any transfer switch, the diesel generators shall be capable of starting automatically without local attendance, reaching synchronous speed and rated voltage and frequency within 10 seconds, and be ready to accept load to the specified overload rating in one step.
4. The system automatic start signal shall not be initiated until a delay of 2 sec has elapsed after a power failure in order to prevent starts due to momentary utility interruptions.
5. During periodic tests, the diesel generator shall be capable of starting on manual signal and being accelerated to synchronous speed and rated voltage within 10 seconds in accordance with NFPA 110.
6. The diesel generators shall be capable of being loaded sequentially in accordance with the requirements delineated in the loading sequence table included at the end of this subsection which, also, refers to the load on the panels indicated on the drawings. The bidder shall propose larger size standard units if his standard rated generator unit cannot meet the specified performance requirements.
7. It is required that the diesel generators be capable of operating up to 2.0 hr at operating speed and less than 20 percent of rated full load and then picking up its sequenced loads with no disruption of power.
8. When loaded sequentially in accordance with the loading summary, the transient voltage drop at any sequence step shall be limited such that the generator voltage is not less than 80 percent of nominal voltage, and frequency is not less than 95 percent of nominal. In addition, the voltage at the generator shall recover to within 100% of nominal voltage and the frequency to within 98% of nominal within 2 sec after each sequential load application.
9. During recovery from transients caused by step load increases, step load decreases, or resulting from 100 percent load rejection, the speed of the diesel generator set shall not reach the overspeed shutdown set point.

E. Diesel Engines:

1. The diesel engines shall be multicylinder, 4 cycle, fuel diesel, turbocharged, stationary type, having removable cylinder liners with a direct injection fuel system, liquid cooled with a unit-mounted radiator, fan, and cooling pump, and positive crankcase ventilation.
2. The engines shall have a continuous horsepower rating when equipped with all engine accessories, including radiator fans; to provide rated diesel generator output at rated speed and frequency under specified ambient conditions.
3. The crankshaft shall be fully counterbalanced. Bearings shall be the precision insertion type, readily replaceable without machining or scraping.

4. Bearings shall be suitable for continuous service. The life of the antifriction bearing shall be the L10 Service Life calculated in accordance with ANSI/ABMA-9 and ANSI/ABMA-11 for the design speed and load condition.
5. The diesel engine generator units shall be completely equipped with all necessary auxiliary systems as hereinafter specified to form a complete package. Industrial control devices, controllers, and assemblies shall be in accordance with NEMA ICS-1, ICS-2, and ICS-6. All control relays shall be provided with dust tight covers.
6. Harmful torsion vibration stresses shall not occur within a range of 10 percent above to 10 percent below rated synchronous speed.
7. Moving parts shall be designed to withstand, without damage, overspeed caused by full extended load rejection, with ample margin to allow the overspeed trip devices to be set sufficiently high to guarantee that the engine-generators will not trip on full extended load rejection.
8. Removable metal guards shall adequately protect exposed rotating parts, such as couplings, bolts, or pulleys.

F. Engine Starting Systems:

1. The diesel engines shall be provided with a dc motor-driven starting system, which shall be capable of starting the engine without outside power. The starting system shall include a heavy-duty electric motor-driven cranking mechanism with overcranking protection, starting battery, battery rack, battery cables, dc voltage regulator, starting battery dual rate float/equalize charger, and complete instrumentation and control systems.
2. A lead-acid type storage battery, 12 V or 24 V, together with rack and connections, shall be provided inside the diesel generator enclosure. The battery shall have sufficient capacity to crank the engine three times at the specified outside ambient temperature without lowering the terminal voltage of the individual cells below 1.6 V. A complete cranking cycle shall consist of an automatic crank period of approximately 15 seconds followed by a rest period of approximately 15 seconds. A high-grade hydrometer shall be included. The battery shall be adequately sealed to prevent the emission of acid fumes and be equipped with explosion resistant vent caps.
3. A static type dual rate float/equalize charger with automatic and manual charge control shall be furnished to service and float the battery and maintain it fully charged from the 120 V, single phase, 60 Hz, alternating current power supply when the unit is stopped. The charger shall operate satisfactorily at the ambient range temperature of -20°F to 115°F and shall be provided with protective fuses, rheostat, DC voltmeter and ammeter. The charger shall have alarm features to provide low battery, high battery voltage and charger malfunction alarms. The charger shall be by LaMarche, or an approved equal.

G. Engine Fuel Systems:

1. The fuel systems shall be equipped with a fuel filter having replaceable elements, which may be easily removed from their housings for replacing without breaking

any fuel line connection or disturbing the fuel pumps or any other part of the engine. Fuel filters shall be conveniently located in one accessible housing, ahead of the injection pumps, so that the fuel will have been thoroughly filtered before it reaches the pumps.

2. The fuel systems shall be furnished with the engine manufacturer's standard electric motor-driven or engine-driven startup fuel pump for 10 second starting.
3. The engine shall be equipped with a built-in gear type, engine-driven fuel pump for supplying fuel through the filters to the injection pumps at constant pressure.
4. The engine shall be suitable for #2 low sulfur winterized diesel fuel so that low emissions as well as no gelling of fuel will occur.
5. (2) 48 - hour base fuel tank shall be furnished. The base fuel tanks shall be UL Approved, double wall construction. It shall be supplied with normal and emergency vents, 2" locking fill cap, fuel level gauge, low fuel alarm contacts and remote rupture alarm panel. The fuel tanks shall be equipped with a 2" port to connect a sensor to the Tank Monitoring System. The fuel tanks shall provide sufficient fuel for 48 hours at 75% load. The fuel system shall be equipped with a fuel filter having replaceable elements which may be easily removed from their housings for replacing without breaking any fuel line connection or disturbing the fuel pumps or any other part of the engine. Fuel filters shall be conveniently located in one accessible housing, ahead of the injection pumps, so that the fuel will have been thoroughly filtered before it reaches the pumps.

H. Engine Cooling Systems:

1. The diesel engines shall be water-cooled, glycol anti-freeze protected, and the cooling system shall consist of a direct, engine-driven water circulating pump, water temperature regulating valves, unit-mounted radiator with blower fan, radiator air discharge duct adapter, and necessary pipe fittings and lagging.
2. The engine cooling water systems shall be equipped with an engine-mounted, thermostatically controlled. The coolant heater shall keep the cooling water warm when the engine is not running, thereby maintaining the diesel generator set in a ready-to-start condition.
3. A rigid guard shall enclose both top and sides of all moving parts between the engine and the radiator.

I. Engine Lubrication Systems:

1. The engine lubrication systems shall be integral with the engine and be positive in action. It shall include a direct engine-driven gear type lubricating oil pump, lubricating oil filters, all piping, valves, and control devices to form a complete lubrication system.
2. Lubricating oil filters shall be of the multiple elements, continuous full flow type, utilizing suitable filtering media.

J. Engine Air Intake System: The diesel engine shall be provided with one or more dry type, replaceable element, and air cleaners.

K. Engine Exhaust System: The exhaust systems for the diesel engine shall consist of a continuous flexible high temperature stainless steel exhaust connector with flanged connections at both ends, and a muffler with flanged connections at both ends, tapped for drainage. The muffler shall be suitable for critical type silencing and shall be Maxim M51 with side inlet or approved equal.

L. Engine Speed and Load Control Systems:

1. The engine speed and load control system for the engine-generator set shall consist of a suitable electronic isochronous governor and all necessary equipment, for controlling the engine speed. Mechanical governors are not acceptable.
2. A separate overspeed device, independent of the governor, shall be provided to prevent engine runaway in the event of any failure which may render the governor inoperable.

M. Engine Protection Systems:

1. The diesel engines shall be provided with a system of automatic controls designed to initiate engine alarm and shutdown sequences to prevent damage or destruction of the engine should a malfunction occur during operation. The controls shall be of a positive-action type and shall contain electrical contacts to be used for energizing the alarm, trip, and shutdown devices. The pressure and temperature alarm controls shall be set to operate before the shutdown controls to provide warning of impending shutdown. The engine protection systems shall be integrated with the alarm, trip, and shutdown control systems described under Part 2.1P "Generator and Excitation Protection Systems."
2. Automatic engine, shutdown shall be initiated by any one of the following conditions:

   a. High engine cooling water temperature
   b. Low lubricating oil pressure
   c. Engine overcrank

3. The manufacturer representative shall advise the Engineer and the Installer of any additional alarm and shutdown devices they consider necessary and that they intend to furnish for the safe operation and protection of the units.

N. Generators:

1. The Generators shall be designed, manufactured, and tested in accordance with NEMA MG1 and ANSI C50.10.
2. The Generators shall be mounted on the common base with its respective engine driver and shall be directly connected to the engine by means of a suitable coupling. It shall be self-ventilated, drip-proof construction.
3. The Generators shall have a continuous standby rating at rated speed, 0.8 pf lagging, 208/120 V, 3 phase, 60 Hz. It shall be Wye-connected and shall be capable of

satisfactorily meeting the starting, loading, and voltage drop requirements as delineated in "Performance Required," without exceeding temperature rises specified by NEMA MG1 for a continuous standby rated generator. The minimum rating of the generator shall be as specified on the plans at 105°~~F~~C temperature rises.

4. Both ends of each phase of the stator windings shall be brought out through suitably rated copper bus terminal box, providing adequate space for connection of the power cables at the bottom of the generator. The insulation for the starter windings, the rotor windings and for the exciter windings shall be class H as defined in the ANSI Standard C50.10.
5. The Generators shall be capable of 350% minimum motor start kVA with 100% voltage recovery.
6. The insulation for the stator windings, the rotor windings, and for the exciter windings shall be Class H, as defined in ANSI Standard C50.10.
7. Insulation shall be treated to make it of the sealed type, suitable for protection against severe moisture, oil, chemicals, and abrasive dust.
8. The Generators and its output terminals shall be properly designated to identify the phase sequence.
9. The Generators short-circuit capability, wave shape, telephone influence factor, and overspeed requirements shall meet those delineated in ANSI Standards C50.10 and MG-1.
10. The-stator frame shall be provided with one unpainted copper ground pad for the Purchaser's ground connection. Ad shall be drilled and tapped for a standard NEMA 2-hole connection in accordance with NEMA CC1-4.05.
11. Generator bearings shall be suitably insulated, where necessary, to prevent the flow of shaft currents.

O. Excitation Systems:

1. The generators shall be equipped with a fast response, continuously acting, and permanent magnet generator excitation system, consisting of a brushless rotary type main exciter and a static voltage regulator. The exciter shall be capable of remote control to raise and lower the voltage. The exciter shall be capable of providing sustained fault current in excess of rated output current for selective tripping of downstream molded case circuit breakers.
2. The excitation systems shall have the capability of minimizing voltage disturbances and maintaining the generator output voltage within acceptable limits during the starting and acceleration of induction motors as described in the starting, loading, and voltage drop requirements delineated in Part 2.1.G, "Engine Fuel System". The voltage regulator shall be high speed, continuously acting, and shall be suitable for maintaining normal operating voltage within plus or minus 0.5 percent.

P. Generator and Excitation Protection Systems:

1. The generators and its respective excitation systems shall be provided with a system of automatic controls designed to initiate generator alarm and trip sequences to prevent damage or destruction of the generator should a malfunction occur during

operation. The controls shall be of a positive-action type and shall contain electrical contacts to be used for energizing the alarm, trip, and shutdown devices. The manufacturer shall provide means for shorting or de-energizing the generator field upon engine shutdown.

2. Automatic generator trip shall be initiated by conditions, which shut down the engine.
3. The manufacturer representative shall state any additional alarm and trip devices they consider necessary and propose to furnish for the safe operation and protection of the generators and excitation systems.

Q. Generator Set Mountings: The diesel generator sets shall be equipped with factory installed vibration isolators mounted between the set and the fabricated steel base to prevent the distortion of alignment between generator and engine when installed. The vibration isolators shall be seismic rated. The equipment shall be mounted on and anchored to a concrete slab by the Installer. The vibration isolators shall be as required by the generator set manufacturer.

R. Vibration and Balance: All equipment as assembled units shall operate with minimum vibration throughout the operating range.

S. Generator Circuit Breakers: A main generator output line 3 pole circuit breaker with solid state trip, 100% rated, shall be unit-mounted as shown on the drawings on each generator. It shall operate both manually as an isolation switch and automatically during overload and short-circuit conditions. The generator circuit breaker shall be sized to carry generator rated output in accordance with NFPA-110 and NEC, shall be UL listed, and shall meet applicable NEMA standards.

T. Shop Cleaning and Painting:

1. Component parts of the diesel generator system shall be cleaned during final assembly to provide the assembled units free of all foreign material such as chips, waste, mill scale, weld rod spatter, oil, grease, or other deleterious material. Chlorinated solvents shall not be used. Openings shall be closed immediately after cleaning. Rust, if any, shall consist of not more than a surface film discoloration that can be readily removed by wiping.
2. After completion of testing, the Contractor shall clean, prime, and finish paint all external metal parts, with the exception of machined and bright surfaces. The priming coat shall contain a rust inhibiting pigment.
3. No filler shall be used before painting. The coating shall be applied only on dry, clean surfaces, after removal of all oil, paraffin, or grease with a suitable solvent.
4. Exposed, machined, and bright surfaces subject to corrosion, with the exception of abutting joints and base-plates, shall be coated as soon as practicable after acceptance by the manufacturer's inspector, with a suitable petroleum grease or rust-inhibiting compound.

2.2 DIESEL FUEL-OIL SYSTEM

A. Comply with NFPA 30.

B. Piping: Fuel-oil piping shall be Schedule 40 black steel, or as recommended by the manufacturer.

C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.

D. Fuel Filtering: Remove water and contaminants larger than 1 micron.

E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Fuel-Oil Storage Tank: Comply with requirements of manufacturer.

1. Consult tank manufacturers about capacities available for size of set in Project.

2. Fuel Tank Capacity: Minimum 133 percent of total fuel required for periodic maintenance operations between fuel refills plus fuel for the hours of continuous operation required for the indicated EPSS Class.

G. Subbase-Mounted, Double-Wall, Fuel-Oil Tanks: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:
1. Tank level indicator.
2. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for periodic maintenance operations between fuel refills, plus fuel for the hours of continuous operation for indicated EPSS class.
3. Vandal-resistant fill cap.
4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.3 CONTROLLER:

A. Standards:

1. Control must meet NFPA-110 Level 2 requirements
2. NFPA-99 and NEC must also be accommodated.
3. The generator set control must be listed under UL 508.

B. Applicability:

1. For standardization purposes, the control described herein must be available on generator sets 20 kW and larger.
2. The control must be usable on 12- or 24-volt starting system.
3. Environment:

a. -40°C to +70°C operating temperature range
b. 5-95% humidity, non-condensing

4. It shall be possible to mount the control on the generator sets or remotely within 40 feet of the generator set. If mounted on the generator, the control must be able to be mounted in any of 4 orientations for ease of viewing.

C. Hardware Requirements:

1. The control shall have a run-off/reset-auto three-position selector switch. If required, in the plans and specs, a version of the control shall have a key operated selector switch.
2. A controller mounted latch type emergency stop push button must be supplied.
3. It shall be possible to adjust alternator output voltage at the control.
4. Five indicating lights as follows:

   a. System ready – green
   b. Not in auto – yellow
   c. Programming mode – yellow
   d. System warning – yellow
   e. System shutdown - red

5. Lighted display with two lines of 20 alphanumeric characters for messages. Panel lights must be supplied as standard.
6. Sealed keypad for menu selection and data entry.
7. For ease of use, an operating guide must be on the controller faceplate.

D. Control Functional Requirements:

1. Field programmable time delay for engine start. Adjustment range, 0-5 minutes in 1 second increments.
2. Field programmable time delay engine cooldown. Adjustment range, 0-10 minutes in 1 second increments.
3. It shall be possible to start the generator and run it at an idle speed during warm-up. The idle time must be user adjustable. Engine cooldown at idle must also be available. Required for ECM equipped engines only.
4. Real time clock and calendar for time stamping of events.
5. Output with adjustable timer for an ether injection starting system. Adjustment range, 0-10 seconds.
6. Output for shedding of loads if the generator reaches a user programmable percentage of its kW rating. Load shed must also be enabled if the generator output frequency falls below 59 Hz (60 Hz system) or 49 Hz (50 Hz system).
7. Programmable cyclic cranking that allows up to six crank cycles and up to 15 seconds of crank time per crank cycle.
8. The capability to reduce controller current battery draw, for applications where no continuous battery charging is available, must be provided.

9. The controller firmware must provide alternator protection for overload and short circuit matched to each individual alternator and duty cycle.
10. A ± 0.25% digital voltage regulator must be incorporated into the controller software. No separate voltage regulator is acceptable. The digital voltage regulator must be applicable on single or three phase systems.
11. It must be possible to exercise the generator by programming a running time into the controller. This feature must also be enabled through the PC software.

E. Generator System Monitoring Requirements: All monitored functions must be viewable on the digital display.

1. The following generator functions must be monitored:

   a. All output voltages - single phase, three phase, line to line, and line to neutral, 0.25% accuracy
   b. All single phase and three phase currents, 0.25% accuracy
   c. Output frequency, 0.25% accuracy
   d. Power factor by phase with leading/lagging indication
   e. Total instantaneous kilowatt loading and kilowatts per phase, 0.5% accuracy
   f. kVARS total and per phase, 0.5% accuracy
   g. kVA total and per phase, 0.5% accuracy
   h. kW hours

2. Engine parameters listed below shall be monitored:

   a. Coolant temperature both in English and metric units
   b. Oil pressure in English and metric units
   c. Battery voltage
   d. Rpm
   e. Lube oil temperature
   f. Lube oil level
   g. Fuel level
   h. Crankcase pressure
   i. Coolant level
   j. Coolant pressure
   k. Fuel pressure
   l. Fuel temperature
   m. Fuel rate
   n. Fuel used during the last run
   o. Ambient temperature

3. Operational records since system startup must be stored in the controller:

   a. Run time hours
   b. Run time loaded

c. Run time unloaded
d. Number of starts
e. Factory test date
f. Last run data including date, duration, and whether loaded or unloaded
g. kW hours

4. The following operational records must also be available in a resetable form for maintenance purposes:

a. Run time hours
b. Run time loaded
c. Run time unloaded
d. Kilowatt hours
e. Days of operation
f. Number of starts
g. Start date after reset

5. The controller must store the last 32 generator system events with date and time of the event.
6. For maintenance and service purposes, the following information must be stored in the control and displayed on demand:

a. Manufacturer's model and serial number
b. Battery voltage
c. Generator set kilowatt rating
d. Rated current
e. System voltage
f. System frequency
g. Number of phases

F. The control must be capable of detecting the following conditions, indicate if the condition will shutdown the generator or provide a warning, and annunciate the situation, using words and phrases, on the digital display.

1. Will cause a system shutdown:

a. Air damper tripped (if used)
b. Customer programmed digital auxiliary input ON (any of the 21 inputs available)
c. Customer programmed analog auxiliary input out of bounds (any of 7 inputs for ECM equipped engines and 5 inputs for non ECM engines)
d. Emergency stop
e. High coolant temperature
f. High oil temperature
g. Controller internal fault
h. Locked rotor - fail to rotate

i. Low coolant level
j. Low oil pressure
k. Master switch error
l. NFPA common alarm
m. Overcrank
n. Overspeed with user adjustable level range 65-70 Hz on 60 Hz systems and 55-70 Hz on 50 Hz systems
o. Generator overvoltage with user adjustable level range 105% to 135%
p. Overfrequency with user adjustable level range 102% to 140%
q. Underfrequency with user adjustable level range 80% to 90%
r. Generator undervoltage with user adjustable level range 70% to 95%
s. Coolant temperature signal loss
t. Oil pressure gauge signal loss

2. Will cause a warning but leave the generator running:

a. Battery charger failure
b. Customer programmed digital auxiliary input on (any of the 21 inputs available)
c. Customer programmed analog auxiliary input on (any of the 7 inputs available on ECM engines and 5 inputs for non ECM engines)
d. Power system supplying load
e. Ground fault detected - detection by others
f. High battery voltage - Level must be user adjustable.
g. Range 14.5 to 16.5 volts for 12-volt system and 29-33 volts for 24-volt systems.
h. High coolant temperature
i. Load shed
j. Loss of AC sensing
k. Underfrequency
l. Low battery voltage – level must be user adjustable Range 10-12.5 volts for 12-volt systems and 20-25 volts for 24-volt systems.
m. Low coolant temperature
n. Low fuel level or pressure
o. Low oil pressure
p. NFPA common alarms
q. Overcurrent
r. Speed sensor fault
s. Weak battery
t. Alternator protection activated

G. Inputs and Outputs:

1. Inputs:

a. There shall be 21 dry contact inputs that can be user configured to shutdown the generator or provide a warning.
b. There shall be 7 user programmable analog inputs for ECM engines (5 for non ECM engines) for monitoring and control.

1) Each analog input can accept 0-5 volt analog signals.
2) Resolution must be 1 part in 10,000.
3) Each input can be programmed to provide up to 4 trip values – 2 warnings and 2 shutdowns.
4) It must be possible to view the analog value on the display.

c. It shall be possible to define each user configured input using words or phases that will be viewable on the digital display.
d. Additional standard inputs required:

1) Input for an external ground fault detector. Digital display must show "ground fault" upon detection of a ground fault.
2) Reset of system faults.
3) Remote two wire start.
4) Remote emergency stop.
5) Idle mode enable.

2. Outputs:

a. All NFPA 110 Level 2 outputs must be available.
b. There shall be thirty outputs available for interfacing to other equipment:

1) Any of these outputs shall be able to be user configured from a list of over 25 functions and faults.
2) These outputs shall drive optional dry contacts.

c. A programmable user defined common fault output with over 40 selections shall be available.

H. System Programming

1. It must be possible to disable programming so the system can only be monitored.
2. It shall be possible to program the control with the controller keypad or using an IBM compatible personal computer.
3. Programming access is to be enabled only at the controller and must be password protected.
4. The generator shall be programmed to exercise weekly with one test per month being under load, time and day of test to be directed by the engineer. For sites with building automation systems the Contractor shall hire TRANE and TRANE will be responsible for programing, installation of any modules, interfacing with existing BAS, engineering, and any equipment and wiring required for the successful

connection to the BAS. The existing BAS shall perform the following functions: activate the weekly exercise function, monitor generator status indicating "Generator Running and Supplying Load", and monitor the transfer switch position (normal or emergency power).

a. TRANE Contact: Alan Berard - 860-616-6514

5. The following must be programmable from the controller keypad:

   a. Time delay settings:

      1) Generator run time (0 to 72 hours) – exercise
      2) Load shed
      3) Engine start
      4) Engine cooldown
      5) Overvoltage and undervoltage delays
      6) Starting aid
      7) Crank on and crank pause time
      8) Idle time

   b. Trip point settings:

      1) High battery voltage
      2) Low battery voltage
      3) Overspeed
      4) Underfrequency
      5) Overfrequency
      6) Overvoltage
      7) Undervoltage
      8) Load shed

I. Communications:

1. If the generator engine is equipped with an ECM (engine control module), the controller must communicate to the ECM for control, monitoring, and diagnostics. SAE J1939 standard communications is required.
2. Industry standard Modbus RTU communication shall be available.

   a. A Modbus master will be able to monitor controller data.
   b. A Modbus master will be able to alter parameters.
   c. The Modbus master must be capable of starting and stopping the generator.

J. Communications & Personal Computer Software

1. The controller must have the capability to communicate to a personal Windows compatible computer. Both RS-232 and RS-485 communication formats shall be available.

2. A variety of connections shall be available based on requirements:

   a. A single connection to a PC. A cable length of up to 4000 feet must be supported.
   b. Multiple devices at a single location connected to a PC.
   c. A single connection from a device to a PC over phone lines.
   d. Multiple devices to a PC over phone lines.

3. When equipped with communications modules, transfer switches and power monitors along with generator controllers must be able to be connected to the same communication network with no additional interfaces being required.
4. The capability to connect up to 128 devices (genset controls and transfer switches) on a single network must be supported.
5. Cabling is to be device to device in a daisy chain fashion with no limitation on device locations within the network.
6. The network must be self- powered. No power wiring between devices is allowed.
7. A single software package with the following capabilities is required:

   a. Any combination of transfer switches and generator controls.
   b. Up to 128 devices at a single site must be supported.
   c. The same software package must support communications over phone lines. The software shall allow communications with up to 128 sites (phone numbers) including phone number fields large enough for International communication.
   d. Access to individual devices by the software shall be protected by password.
   e. To support future expansion, it must be possible to add devices (ATS and generator set controllers), up to 128 and sites up to 128, with the installed software. Changing to a different software package is not acceptable.

8. All displays, data inquires, and program functions allowed on the controllers, both generator and ATS, shall also be available through the software.
9. A single software screen must be capable of displaying data from multiple devices simultaneously.
10. It shall be possible to reset shutdown faults, and restart the generator using the software.

K. Loading Sequence Table:

1. At time = 0 sec, the diesel generator set is at rated speed and voltage and ready to accept load, and no more than 9 sec have elapsed from the initial loss of power.
2. At time = 0 sec, ATS-1 shall energize Main Distribution Panel (MDP) and all loads connecting thereto.

   <u>NOTE: The loads on this panel are shown on the plans</u>.

3. If additional sequencing is required because of diesel generator limitations, the manufacturer shall recommend and the installer shall provide such sequencing, using contactors on individual loads, at no additional charge. The designer shall approve such additional sequencing.

2.4 ENCLOSURE STANDARD TYPE:

A. Weatherproof Sound Enclosures:

1. The generators shall be equipped with shut-down button in location indicated on the plans.
2. Provide a 14 gauge aluminum, weatherproof, insulated enclosure. The enclosures shall be of modular design with gasketed roof bolts, gravity-operated louvers (fixed with intake and exhaust hoods), and a rain ledges. The enclosure is to be in compliance with the NEC and the NFPA with regard to clearance around electrical equipment as specified. Provide sufficient space for skid base tank, space heaters and other specified equipment.
3. The enclosures shall conform to the following design criteria:

    a. Rigidity wind test equal to 115 mph.
    b. Roof load equal to 50 lbs. per sq. ft.
    c. Rain test equal to 4-inches per hour.
    d. The enclosure walls and roof shall have 2 inches of thermal insulation.

4. The roof shall be flanged lap rain tight construction, with stiffeners. Two access doors shall be provided along two sides of the generator. Doors shall have heavy duty, stainless steel, hinges. Doors shall have locks all keyed alike.
5. Louvers shall be appropriately sized for the size of the engine to ensure proper operation of the generator.
6. The complete enclosure shall be primed and painted at the factory using manufacturer applied methods. Color shall be gray or approved equal. Final color selection shall be approved by Designer.
7. Gravity operated dampers shall drive air intake and exhaust louvers. The gravity operated dampers shall be of tight-fitting construction and of proper size for engine cooling airflow. The enclosure should be fitted with spring open – motor closing louvers and these should be closed as soon as possible after stopping of the machine, consistent with avoiding abnormal temperature built-up. All enclosure parts must either be galvanized or powder coated or painted with a salt-resistant paint to avoid corrosion and particular care must be taken with areas where moisture can be trapped. Gravity operated louvers are not required with intake and exhaust hoods.
8. The generator sets shall be mounted on a skid base consisting of two structural channel main rails and heavy plate mounting pads.
9. The units shall include an extended ground bolt stud and provisions for outgoing power and signal cables.

10. The units shall include gas cocks and nipples to the engine, along with flexible oil-resistant lines, for easy engine maintenance.
11. The enclosure shall include the specified battery racks, batteries, and cables, permanently located for convenient servicing.
12. The critical exhaust silencer shall be mounted inside of the enclosure and secured with welded support brackets.
13. Provide diesel tanks as shown on the drawings (or larger, depending upon the gallons of fuel consumed per hour by the generator run at 75% of full load rating for a period of 48 hours), double wall base fuel tank. The tank shall conform to UL142 requirements including construction and testing. The tank shall be equipped with normal and emergency vents, locking fill cap, mechanical fuel level gauge, 110% rupture basin, remote rupture alarm panel, low fuel level alarm and any other accessories required to meet State and Local Codes.
14. The generator base tanks shall be provided with an additional 2" port to connect a probe for measuring diesel and communicating the readings to the Tank Monitoring System (TMS) within the building.

B. Generator Equipment Branch Circuits:

1. The Installer shall provide an interior electrical distribution system, complete with EMT conduit (minimum conduit size shall be ¾"), and Separate circuits for the engine block heater, receptacle, and battery charger. Circuits shall be installed per manufacturer's recommendations, circuits shall originate as indicated on plans.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Manufacturer's Field Representatives for Erection and Start-up.

1. The manufacturer shall furnish the services of competent erection and start-up field representatives and shall make such persons available for the periods of time required for the start-up of the diesel-generator systems and the testing thereof, as specified herein.
2. The field representatives shall furnish all possible information and advice to assist the Installer and/or the Engineer in attaining a properly installed, missioned, and tested installation. The field representative shall be responsible to show the Department the proper operational and maintenance features of the equipment.
3. If any field representative encounters anything not consistent with these goals, he shall immediately call the matter to the attention of the parties directly concerned. If the situation is not then rectified, the field representative shall immediately confirm his objection in writing, with copies thereof delivered to both the Installer and the Engineer.

4. The work and operations of the field representatives shall be coordinated with the program of construction at the joist, as directed by the Installer.
5. In the event that the furnished equipment requires repairs or replacements effected by the field representative during erection, start-up, or under warranty, a detailed written report which lists the repairs or replacements made, the identity of the parts replaced or repaired, along with a brief description of the causes of failure, analysis of the failure if requested, and the date of repair completion, shall be submitted to the Engineer.

B. Ground equipment according to CSI Section 260526 "Grounding and Bonding for Electrical Systems."

C. Provide generator signage according to CSI Section 260553 "Identification for Electrical Systems."

3.2 TESTING:

A. Engage an independent qualified testing agency to perform tests and inspections and prepare reports as stated in section 3.2-D.

B. Contractor shall have all new plumbing/mechanical equipment installed and tested prior to generator acceptance testing

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections, Report results in writing.

D. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Stand-by Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

   a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
   b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
   c. Verify acceptance of charge for each element of the battery after discharge.
   d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at two locations on the property line and compare measured levels with required values.

E. Coordinate tests with tests for transfer switches and run them concurrently.

F. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

G. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

J. Remove and replace malfunctioning units and retest as specified above.

K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

L. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

M. Infrared Scanning: Perform the following infrared scan tests and inspections and prepare reports:

1. Initial Infrared Scanning: After Substantial Completion, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
2. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each power wiring termination and each bus connection after the semi-final inspection.
3. Record of Infrared Scanning: Prepare a report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
4. Instruments and Equipment:
    a. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3.3 TRAINING:

A. Refer to Form 818 Article 1.20 – 1.08.14 Subsection 3 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain generator and related equipment as specified.

C. Coordinate this training with that for the ATS equipment.

END OF SECTION 263213

SECTION 263600 – TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.
2. Remote annunciation and control systems functionality.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20 – 1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch.

1.3 QUALITY ASSURANCE:

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the NETA or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the NETA or the NICET to supervise on-site testing specified in Part 3.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA ICS 1.

E. Comply with NFPA 70.

F. Comply with NFPA 99.

G. Comply with NFPA 110.

H. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.4 WARRANTIES:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. The ATS's shall be warranted by the manufacturer for 5 years or 3,000 hours, whichever occurs first, from the date of the issuance of the Certificate of Compliance. The vendor must be the authorized distributor of all major components and must provide documentation supporting their ability and authority to perform all warranty service and repairs. The warranty shall cover both parts and labor for the complete warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that shall be incorporated into the Work include the following:

1. Automatic Transfer Switches:

a. Cummins Power Systems
b. Kohler Power Systems
c. Russ Electric
d. Caterpillar
e. MTU Onsite Energy (Atlantic Power Systems)
f. ASCO

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS:

A. General: The automatic transfer switches shall be rated, for use in a 208/120 VAC, 3 phase, 4 wire, 3 pole. Refer to plans for size and interrupting capacity of each automatic transfer switch.

B. Ratings: Each automatic transfer switch ratings and number of poles shall be as shown on the drawings. The complete switch assembly ratings shall be listed under UL-1008 for use on stand-by systems.

C. Responsibility:

1. The Installer shall provide an automatic transfer switch as shown on the drawings and as specified herein. The ATS shall be UL listed to UL-1008 and shall be in accordance with NEC Article 700 and NFPA- 110.
2. The Diesel Generator Manufacturer, Installer, and Transfer Switch Manufacturer shall each ensure that all interfaces between the transfer switch and the diesel generator, including control wiring, diesel generator load sequencing, and operating requirements, are properly coordinated.
3. The transfer switch shall be considered part of the standby system. The diesel generator manufacturer shall be responsible for the coordination and warranty of the entire standby system, including the automatic transfer switch.

D. Construction:

1. The transfer switches shall be mounted in a NEMA 1 enclosure, NEMA 3R enclosure, NEMA 4X enclosure as indicated on the plans. Enclosures shall be fabricated from 12-gauge steel. The enclosure shall be sized to exceed minimum wire bending space required by UL 1008.
2. The transfer switches shall be equipped with an internal welded steel pocket, housing an operations and maintenance manual.
3. The transfer switches shall be top and bottom accessible.
4. The main contacts shall be capable of being replaced without removing the main power cables.
5. The main contacts shall be visible for inspection without any major disassembly of the transfer switch.
6. All bolted connections shall have Belleville compression type washers.
7. When a solid neutral is required, a fully rated bus bar with required AL-CU neutral lugs shall be provided.
8. Control components and wiring shall be front accessible. All control wires shall be multiconductor 18 gauge 600-volt SIS switchboard type points to point harness. All control wire terminations shall be identified with tubular sleeve-type markers.
9. The switches shall be equipped with 90 degrees C rated copper/aluminum solderless mechanical type lugs.

10. The complete transfer switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available upon request.

E. Automatic Transfer Switches:

1. The transfer switches shall be double throw, actuated by two electric operators momentarily energized, and connected to the transfer mechanism by a simple over center type linkage. Minimum transfer time shall be 400 milliseconds.
2. The normal and stand-by contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and stand-by positions without the use of hooks, latches, magnets, or springs, and shall be silver-tungsten alloy. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches. Interlocked, molded case circuit breakers or contactors are not acceptable.
3. The transfer switches shall be equipped with a safe external manual operator, designed to prevent injury to operating personnel. The manual operator shall provide the same contact to contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.

F. Automatic Transfer Switches Controls:

1. The transfer switches shall be equipped with a microprocessor based control system to provide all the operational functions of the automatic transfer switch. The controller shall have two asynchronous serial ports. The controller shall have a real time clock with Nicad battery back up.
2. The CPU shall be equipped with self-diagnostics, which perform periodic checks of the memory I/O and communication circuits, with a watchdog/power fail circuit.
3. The controller shall use industry standard open architecture communication protocol for high-speed serial communications via multidrop connection to other controllers and to a master terminal with up to 4000 ft of cable, or further, with the addition of a communication repeater. The serial communication port shall be RS232/485 compatible.
4. The serial communication port shall allow interface to the manufacturer's furnished remote supervisory control.
5. The controller shall have password protection required to limit access to qualified and authorized personnel.
6. The controller shall include a 20 character, LCD display, with a keypad, which allows access to the system.
7. The controller shall include three-phase over/under voltage, over/under frequency, and phase sequence detection and phase differential monitoring on both normal and emergency sources.

8. The controller shall be capable of storing the following records in memory for access either locally or remotely:

    a. Number of hours transfer switch is in the emergency position (total since record reset).
    b. Number of hour's standby power is available (total since record reset).
    c. Total transfer in either direction (total since record reset).
    d. Date, time, and description of the last four source failures.
    e. Date of the last exercise period.
    f. Date of record reset.

G. Sequence of Operation:

1. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increases to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant.
2. The transfer switches shall transfer to stand-by when the generating plant has reached specified voltage and frequency on all phases.
3. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the stand-by power source should fail during this time delay period, the switch shall automatically return to the normal source.
4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds.

H. Automatic Transfer Switches Accessories:

1. Programmable three phases sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency Programmable voltage differential between phases, set at 20% and phase sequence monitoring.
2. Programmable three phases sensing of the stand-by source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20% and phase sequence monitoring.

3. Time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation). Programmable 0-9999 seconds. Factory set at seconds, if not otherwise specified.
4. Time delay to control contact transition time on transfer to either source. Programmable 0-9999 seconds, factory set at 3 seconds.
5. Time delay on retransfer to normal, programmable 0- 9999 seconds, factory set at 300 seconds if not otherwise specified, with overrun to provide programmable 0-9999 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal.
6. Time delay on transfer to emergency, programmable 0- 9999 seconds, factory set at 3 seconds.
7. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.
8. A remote type load test switch shall be included to simulate abnormal power failure, remote switch initiated.
9. A time delay bypass on retransfer to normal shall be included. Keypad initiated.
10. Contact rated 10 Amps 30 volts DC, to close on failure of normal source to initiate engine starting.
11. Contact rated 10 Amps 30 volts DC, to open on failure of normal source for customer functions.
12. Light emitting diodes shall be mounted on the microprocessor panel to indicate: switch is in normal position, switch is in emergency position and controller is running.
13. The ATS's shall be capable of receiving a remote signal from closed contacts of the building automation system to activate the weekly exercise function ("under load exercise sequence"), which will run as long as the contacts are closed. The generator shall be capable of providing status information to the building automation system. The ATS's shall start the generator, transfer, and shall close a set of auxiliary contacts that the automation system will monitor to indicate that the "Generator Running and Supplying Load" on the automation system. The load shall transfer back to commercial power after an adjustable time upon the opening of automation system signal contacts. The generator shall automatically shut down after an adjustable cool down time. The ATS's shall be able to communicate with any Building Automation System (BAS) such as TRANE controls, Johnson controls, etc. The Contractor shall ensure compatibility between systems. The Contractor is responsible for any additional component, accessory, wiring, conduit, etc. required for the complete installation and operation of the system.
14. Provision to select either "no commit" or "commit" to transfer operation in the event of a normal power failure shall be included. In the "no commit position," the load will transfer to the emergency position unless normal power returns before the stand-by source has reached 90% of its rated values (switch will remain in normal). In the "commit position" the load

will transfer to the emergency position after any normal power failure. Keypad initiated.

15. Each ATS shall have four auxiliary contacts rated 10 Amp, 120 volts AC (for switches 100 to 800 amps) shall be mounted on the main shaft, one closed on normal, the other closed on stand-by. Both contacts will be wired to a terminal strip for ease of customer connections. In addition, 2 sets of Form C relay contacts shall be provided to indicate loss of utility power.
16. A three phase digital LCD voltage readout, with 1% accuracy shall display all three separate phase to phase voltages simultaneously, for both the normal and stand-by source.
17. A digital LCD frequency readout with 1-% accuracy shall display frequency for both normal and stand-by source.
18. An LCD readout shall display normal source and stand-by source availability.

I. The following accessories shall be available by simple activation, via the key pad, if required.

1. Include (2) time delay contacts that open simultaneously just (milliseconds) prior to transfer in either direction. These contacts close after a time delay upon transfer. Programmable 0-9999 seconds after transfer.
2. A block transfer function shall be included, energized from a 24VDC signal from the generator control switchgear, to allow transfer to standby.
3. A load-shed function shall be included, energized from a 24VDC signal from the generator control switchgear, to disconnect the load from the standby source when an overload condition occurs.
4. A peak shave function shall be included, energized from a 24VDC signal from the generator control switchgear. This function will start the standby generator and transfer the ATS to the standby source reducing the utility supply to the building. After the peak shave signal is removed, the transfer switch will retransfer to the normal supply, bypassing the retransfer time delay.

J. Approval:

1. As a condition of approval, the manufacturer of the automatic transfer switches shall verify that their switches are listed by Underwriters Laboratories, Inc., Standard UL-1008 with 3 cycle short circuit closing and withstand as indicated on plans or per Arc-Flash Study whichever is higher.
2. During the 3 cycle closing and withstand tests, there shall be no contact welding or damage. The 3 cycle tests shall be performed without the use of current limiting fuses. The test shall verify that contact separation has not occurred, and there is contact continuity across all phases. Test

procedures shall be in accordance with UL-1008, and UL shall certify testing.

3. When conducting temperature rise tests to UL-1008, the manufacture shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests.
4. The microprocessor controller shall meet the following requirements:

    a. Storage conditions - 25 degrees C to 85 degrees C.
    b. Operation conditions - 20 degrees C to 70 degrees C ambient.
    c. Humidity 0 to 99% relative humidity, noncondensing.
    d. Capable of withstanding infinite power interruptions.
    e. Surge withstand per ANSI/IEEE C-37.90A-1978.

5. Manufacturer shall provide copies of test reports upon request.

K. Manufacturer:

1. The transfer switch manufacturer shall employ a nationwide factory-direct, field service organization, available on a 24-hour a day, 365 days a year, call basis.
2. The manufacturer shall include an 800-telephone number, for field service contact, affixed to each enclosure.
3. The manufacturer shall maintain records OD each transfer switch, by serial number, for a minimum 20 years.

2.3 REMOTE ANNUNCIATOR AND CONTROL SYSTEM:

A. Functional Description: Include the following functions for indicated transfer switches:

1. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Indication of switch position.
3. Indication of switch in test mode.
4. Indication of failure of digital communication link.
5. Key-switch or user-code access to control functions of panel.
6. Control of switch-test initiation.
7. Control of switch operation in either direction.
8. Control of time-delay bypass for transfer to normal source.

B. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation. Automatic transfer-switch sensing,

controlling, or operating function shall not depend on remote panel for proper operation.

C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:

1. Controls and indicating lights grouped together for each transfer switch.
2. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
3. Digital Communication Capability: Matched to that of transfer switches supervised.
4. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
5. It shall be equipped with an integral alarm horn.

D. Remote Diesel Generator Annunciator:

1. A remote annunciator panel shall be provided with each diesel generator set to give audible and visual indication of:

   a. Mode selector switch "Off" (flashing red)
   b. Overcrank (red)
   c. Emergency stop (red)
   d. High cooling water temperature (red)
   e. Overspeed (red)
   f. Low oil pressure (red)
   g. Anticipatory high cooling water temperature (yellow)
   h. Anticipatory low oil pressure (yellow)
   i. Low cooling water temperature (red)
   j. Battery charger fault (red)
   k. Low battery voltage (red)
   l. System ready (green) - not tied to audible alarm
   m. Base tank rupture (red)
   n. Normal line power (yellow)
   o. Generator power (yellow)
   p. Alarm switch off (red)
   q. Audible alarm with shutoff switch

2. Each remote annunciator panel shall be located where shown on the plans. The Installer shall provide interconnecting cabling as recommended by the manufacturer, minimum No. 14 AWG twisted shielded pair.
3. The Generators shall also provide remote status information to the building automation system for event log monitoring

2.4 SOURCE QUALITY CONTROL:

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Design each fastener and support to carry load indicated according to CSI Division 26 Section 260529, “Hangers and Supports for Electrical Systems.”

B. Annunciator and Control Panel Mounting: Surface mounted, unless otherwise indicated.

C. Identify components according to CSI Division 26 Section 260553, "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS:

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to CSI Division 26 Section 260526, "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to CSI Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL:

A. Testing agency: Engage an independent qualified testing agency to perform tests and inspections.

B. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform the following tests and inspections:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Test unit functional modes and related automatic transfer-switch operations.
    f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
    g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

    a. Verify grounding connections and locations and ratings of sensors.

D. Testing Agency's Tests and Inspections:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Test unit functional modes and related automatic transfer-switch operations.
    f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
    g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

    a. Verify grounding connections and locations and ratings of sensors.

E. Coordinate tests with tests of generator and run them concurrently.

F. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

G. Remove and replace malfunctioning units and retest as specified above.

H. Prepare test and inspection reports.

I. Infrared Scanning: Perform the following infrared scan tests and inspections and prepare reports:

1. Initial Infrared Scanning: After Substantial Completion, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
2. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch after the semi-final inspection.
3. Record of Infrared Scanning: Prepare a report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
4. Instruments and Equipment:
5. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3.4 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 3 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below.

C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes lightning protection for building, rooftop equipment, and associated building equipment.

1.2 DEFINITIONS:

A. NRTL: National Recognized Testing Laboratory.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For air terminals and mounting accessories.

C. Working Drawings: Detail lightning protection system, including air-terminal locations, conductor routing and connections, and bonding and grounding provisions. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

D. Qualification data for firms and persons specified in Part 1.4, "Quality Assurance" to demonstrate their capabilities and experience. Include data on listing or certification by an NRTL or LPI.

E. Certification letter, signed by Contractor, that roof adhesive for air terminals is approved by manufacturers of both the terminal assembly and the roofing system.

F. Field inspection reports indicating compliance with specified requirements.

1.4 QUALITY ASSURANCE:

A. Installer Qualifications: Engage an experienced installer who is an NRTL or who is certified by LPI as a Master Installer/Designer.

B. Listing and Labeling: As defined in NFPA 780, "Definitions" Article.

1.5 COORDINATION:

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Northeast Lightning Protection, LLC.
2. East Coast Lightning Equipment, Inc.
3. Independent Protection Company, LLC.

2.2 LIGHTNING PROTECTION SYSTEM COMPONENTS:

A. Comply with UL 96.

B. Roof-Mounting Air Terminals: NFPA Class I, copper, unless otherwise indicated.

1. Single-Membrane, Roof-Mounting Air Terminals: Designed for single-membrane roof materials.

2. The contractor shall install protective pads under all lightning rod in contact with the roof surface.

C. Stack-Mounting Air Terminals: Solid copper.

D. Ground Rods, Ground Loop Conductors, and Electrodes: Comply with CSI Division 26 Section 260526, "Grounding and Bonding for Electrical Systems" and with standards referenced in this Section.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install lightning protection components and systems according to UL 96A and NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends less than 90 degrees and 8 inches in radius and narrow loops.

C. Conceal the following conductors:

1. System conductors.
2. Down conductors: shall be installed in conduit and shall be concealed from the outside of the building. There should not be any exterior surface mounted conduit.
3. Interior conductors.
4. Conductors within normal view from exterior locations at grade within 200 feet of building.
5. Notify Engineer at least 72 hours in advance of inspection before concealing lightning protection components.

D. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above single-ply membrane roofing.

E. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.

F. Bond extremities of vertical metal bodies exceeding 60 feet in length to lightning protection components.

G. A counterpoise installation based on requirements in CSI Division 26 Section 260526, "Grounding and Bonding for Electrical Systems" may be used as a ground loop required by NFPA 780, provided counterpoise conductor meets or exceeds minimum requirements in NFPA 780.

1. Bond ground terminals to counterpoise conductor.
2. Bond grounded metal bodies on building within 12 feet of ground to counterpoise conductor.
3. Bond grounded metal bodies on building within 12 feet of roof to counterpoise conductor.

H. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot intervals.

3.2 CORROSION PROTECTION:

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.3 FIELD QUALITY CONTROL:

A. Provide an inspection by an inspector certified by LPI to obtain an LPI certification.

END OF SECTION 264113

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes surge protection for low-voltage power, control, and communication equipment.

1.2 DEFINITIONS:

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed Voltage Rating.

C. SPD : Surge Protective Device.

D. SCCR : Short-circuit current rating.

E. MCOV : Maximum continuous operating voltage.

F. MOV : Metal-oxide varistor ; an electronic component with a significat non-ohmic current voltage characteristic.

G. VPR : Voltage protection rating.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.

C. Product Certificates: For transient voltage suppression devices, signed by product manufacturer certifying compliance with the following standards:

1. UL 1283.
2. UL 1449.
3. UL 96a.

D. Qualification Data: For testing agency.

E. Field quality-control test reports, including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

F. Operation and Maintenance Data: For transient voltage suppression devices to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

G. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE:

A. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the NETA or the NICET to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45, "IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."

E. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."

F. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449, "Surge Protective Devices."

1.5 PROJECT CONDITIONS:

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than 7 calendar days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

B. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F.
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet above sea level.

1.6 COORDINATION:

A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

B. Provide transient voltage surge suppressor as required by UL96a, and labeled for lightning protection systems by UL. The contractor shall provide and install the transient voltage surge suppressor in place at the time of inspection for the project to receive a full Master Label.

1.7 WARRANTIES:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors, that fail in materials or workmanship within five years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cutler-Hammer Products; Eaton Corporation.
2. Hubbell Inc. Wiring Device
3. Siemens Industry Inc.

2.2 GENERAL SPD REQUIREMENTS:

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be at least 150 percent of the nominal system voltage.

2.3 SERVICE ENTRANCE SUPPRESSOR:

A. SPDs: Comply with UL 1449.

B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449.

1. SPDs with the following features and accessories:
   a. Indicator light display for protection status.
   b. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
   c. Surge counter.

C. Comply with UL 1283.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 250 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 SVR for grounded circuits with 208/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 600 V for 208Y/120 V.
2. Line to Ground: 800 V for 208Y/120 V.
3. Line to Line: 1000 V for 208Y/120 V.
4. Neutral to Ground: 600 V for 208Y/120V.

F. SCCR: Equal or exceed 250 kA.

G. Nominal discharge current rating: 20kA

2.4 ENCLOSURES:

A. Indoor Enclosures: NEMA 250, Type 1.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTION DEVICES:

A. SPD shall be installed on the load side of the ATS overcurrent protection device. SPD shall be mounted as close as possible to the ATS. Refer to NEC Article 285.

B. External mounted SPD shall be installed per manufacturer's installation instructions with lead lengths as short (less than 24") and straight as possible. Conductors shall be twisted together to reduce inductive losses. Do not bond neutral and ground.

1. Provide fused disconnect for the SPD. Disconnect shall be equipped with fuses sized per SPD manufacture requirements.

3.2 PLACING SYSTEM INTO SERVICE:

A. Do not energize or connect service entrance equipment, panelboards, control terminals, and data terminals to their sources until surge protection devices are installed and connected.

3.3 FIELD QUALITY CONTROL:

A. Manufacturer's Field Service: Engage an independent testing agency to inspect, test, and adjust equipment installation, including connections, and to assist in field testing. Report results in writing.

1. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. Testing: Perform the following field tests and inspections and prepare test reports:

1. After installing surge protection devices, but before electrical circuitry has been energized, test for compliance with requirements.
2. Complete startup checks according to manufacturer's written instructions.
3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

C. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.5 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 3 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transient voltage suppression devices.

END OF SECTION 264313

SECTION 265119 – LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes LED interior lighting fixtures and accessories including egress lighting and exit signs for the complete indoor lighting as shown on plans.

B. Related CSI Sections include the following:

1. Division 26 Section 260519, “Low Voltage Electrical Power Conductors and Cables”.
2. Division 26 Section 260529, “Hangers and Supports for Electrical Systems”.
3. Division 26 Section 260533, "Raceways and Boxes for Electrical Systems".
4. Division 26 Section 260543, “Underground Ducts and Raceways for Electrical Systems”.
5. Division 26 Section 260923, “Lighting Control Devices” for automatic control lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays contactors.
6. Division 26 Section 262726, “Wiring Devices.”

C. Description:

1. The lighting system shall be compatible with the available voltage or as called for on the Contract plans. LED luminaires shall be installed for general interior lighting.
2. Panelboards, fixtures, outlets, receptacles, switches and all other applicable lighting system components and details shall be as shown on the plans or as specified.
3. The plans show the location, number, size and type of lighting units and fixture schedule. All fixtures shall be UL listed.
4. Lighting plans are diagrammatic, with fixture outlets located approximately to scale but not dimensioned. Raceways are not generally shown. The Contractor shall check lighting drawings against field conditions and the drawings of other disciplines for interferences and shall select and lay out locations for outlets and obtain approval for final locations from our field Engineer.

1.2 DEFINITIONS:

A. CCT: Correlated Color Temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-Emitting Diode.

F. Lumen: Measured output of luminaire.

G. Luminaire: Complete lighting unit, including LED module(s), driver, reflector, and housing.

H. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20 – 1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. The Lighting Fixture Schedule within this CSI section indicates three bases of design light fixtures for each fixture type. The contractor shall submit one of each fixture type with all required options selected. No equals shall be permitted.

C. Product Data: Include photometric curves, illustrations, specifications, schedules and material lists with quantities showing complete details of all proposed equipment.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

D. Maintenance Data: For interior lighting to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08-14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE:

A. Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 220, 410 as applicable to installation, and construction of interior building lighting fixtures.

B. Comply with UL standards, including UL 486A and B, pertaining to interior lighting fixtures. Provide interior lighting fixtures and components which are UL-listed.

C. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and label LED for indicated class and division of hazard by FM Global.

1.5 SEQUENCING AND SCHEDULING:

A. Coordinate with other work including conductors and cable, raceways and boxes, to properly interface installation of interior lighting fixtures with other work.

1.6 COORDINATION:

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. One Spare Driver for each fixture type having a fixture total of 8 or more.
2. Two Spare Divers for each fixture type having a fixture total of 16 or more.

1.8 WARRANTIES:

A. Refer to Form 818 Article 1.20 – 1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. All lighting fixtures and components shall carry a manufacturer's warranty covering defects in material and workmanship for a minimum of five (5) years from the issuance of Certificate of Compliance.

C. Replace defective and burned out modules and drivers for a period of one year following the date of Certificate of Compliance.

D. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Power Unit Batteries: five (5) years from date of Substantial Completion. Full warranty shall apply from the issuance of Certificate of Compliance.
2. Warranty Period for Self-Powered Exit Sign Batteries: five (5) years from date of Substantial Completion. Full warranty shall apply from the issuance of Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Three for each fixture type, as specified on the lighting fixture schedule, no equals shall be permitted.

2.2 MATERIALS:

A. General:

1. Lighting fixtures (luminaires) shall be complete with mounting brackets and hardware, LED modules, drivers, installation accessories, fixture wire, and all accessories as required, as specified in the Fixture Schedule, as shown on the Contract plans and as required by NEC.

2. All LED fixtures shall have the following standard options:
   a. 4000K color temperature (excludes exit signs)
   b. Fixture Color: White
   c. Voltage and phasing as indicated on plans, and panel schedules.
   d. Bay Fixture Types A, AE, H, HE, R, RE, & J shall be wired using the appropriate cord and twist lock type receptacle/plug combination per fixture voltage and
      type.
   e. DLC Listed - All light fixtures shall qualify for possible utility rebate/incentives.

3. All Emergency battery backup units shall have the following.
   a. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body
   b. Emergency Connection: Operate fixture continuously upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire driver.
   c. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   d. Test Push-Button and Indicator Light: Visible and accessible. Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

e. Provide a red dot or distinct mark approved by the engineer on all battery back-up light fixtures.
f. Battery for emergency units: NiCad.
g. Integral Self-Test (self-diagnostic): Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

B. Lighting Fixture Schedule: no equals shall be permitted; contractor shall use the most recent version and or generation of the fixtures below.

NAME	DESCRIPTION AND OPTIONS	MIN LUMEN PACKAGE	MANUFACTURER /MODEL 1	MANUFACTURER/MODEL 2	MANUFACTURER/MODEL 3
	Office Area Lighting				
B	2'x 4' Recessed Led, curved center acrylic diffuser design.	**3000**	**LITHONIA** 2VTL4	**GE** LVT24	**PHILIPS** 2EVG
BE	Same as type "B" but with emergency battery backup for emergency egress lighting. Select highest lumen option for battery backup.	**3000**	**LITHONIA** 2VTL4	**GE** LVT24	**PHILIPS** 2EVG
B2	2' x 2' Recessed LED, center acrylic diffuser design.	**2000**	**LITHONIA** 2VTL2	**GE** LVT22	**PHILIPS** 2EVG
B2E	Same as Type "B2" but with emergency battery backup for emergency egress lighting. Select highest lumen option for battery backup.	**2000**	**LITHONIA** 2VTL2	**GE** LVT22	**PHILIPS** 2EVG
	Bay Area Lighting				
A	4' LED, linear suspended, Lensed when available.	**4000**	**LITHONIA** ZL1N	**GE** ALC5 white	**PHILIPS** LBX
AE	Same as Type "A" but with emergency battery backup for emergency egress lighting. Select highest lumen option for battery backup. Lensed when available.	**4000**	**LITHONIA** ZL1N	**GE** ALC5	**PHILIPS** LBX
C	Same as Type "A" but pendent mounted over workbench, with task or narrow distribution. Lensed when available.	**4000**	**LITHONIA** MSL	**GE** ALC5	**PHILIPS** LBX
H	High Bay LED Luminaire	**12000**	**LITHONIA** IBG	**RAB** RAIL	**PHILIPS** FBX
HE	Same as Type "H" but with emergency battery backup for emergency egress lighting. Select highest lumen option for battery backup.	**12000**	**LITHONIA** IBG	**RAB** RAIL	**PHILIPS** FBX
R	High Bay LED Luminaire	**24000**	**LITHONIA** IBG	**RAB** RAIL	**PHILIPS** FBX
RE	Same as Type "R" but with emergency battery backup for emergency egress lighting. Select highest lumen option for battery backup.	**24000**	**LITHONIA** IBG	**RAB** RAIL	**PHILIPS** FBX

J	High Bay LED luminaire, wet location listed, IP65 rated.	**17000**	**LITHONIA** JHBL Glass lens	**RAB** FALCOR	**PHILIPS** HBY
IW	Bay area wall pack, standard cutoff	**6700**	**LITHONIA** TWR2 LED	**RAB** WP3LED	**PHILIPS** WP-LED
	Exit Signs and Emergency Lighting				
X	Single face cast exit sign with red LED illumination. LED Illumination system with enclosed emergency Ni-Cad battery pack. Provides emergency lighting at the bottom of the fixture. Self-diagnostic, white enclosure.	**N/A**	**Isolite** RLP	**EELP** XCLB	**PHILIPS** TPC
X2	Double face cast exit sign with red LED illumination. LED Illumination system with enclosed emergency Ni-Cad battery pack. Provides emergency lighting at the bottom of the fixture. Self-diagnostic, white enclosure.	**N/A**	**Isolite** RLP	**EELP** XCLB	**PHILIPS** TPC
XW	NEMA 4 weatherproof, single face cast exit sign with red LED. LED Illumination System with enclosed emergency Ni-Cad battery pack. Self-diagnostic, white enclosure	**N/A**	**LITHONIA** LV	**EELP** SPCHAHA	**PHILIPS** ER60MLD
XR	Single face cast exit sign with LED Illumination system and enclosed emergency Ni-Cad battery pack. Provides emergency lighting at the bottom of the fixture. Self-diagnostic, white enclosure with exterior LED remote head (Gray)	**N/A**	**Isolite** RLP	**EELP** XCLB	**EXITRONIX** CLED
XH	Single face cast exit sign with LED Illumination System and enclosed emergency Ni-Cad battery pack. Custom  Face: White	**N/A**	**LITHONIA** LQM	**EELP** SWXECT-EA	**EXITRONIX** VEX
EMW	Weatherproof emergency wall mounted lighting unit with 2 LED heads and a Ni-Cad battery. Additional LED exterior remote heads where indicated on plans.	**N/A**	**LITHONIA** WLTU LED	**EELP** WLEM-LED	**EXITRONIX** LED-RX
EMR	Weatherproof emergency LED head with box cover/ Exterior egress light remote head, NEMA rated with weatherproof mounting plate, Gray.	**N/A**	Per Exit Sign Manufacture	Per Exit Sign Manufacture	Per Exit Sign Manufacture
	Restroom Lighting				
SL	LED Shower light		Per shower manufacturer	Per shower manufacturer	Per shower manufacturer
I2	2' LED mirror light fixture with downward angle.	**1500**	**Lithonia** FMVTSL	**TEXAS FLUORESCENTS** BKA	**H. E. Williams** WMA *no uplight

C. Refractors and Reflectors: All glassware and plastic shall be uniform, free from defects and photometrically tested for distribution by an independent testing laboratory. Plastic diffusers shall be of new virgin-acrylic plastic material. Designer reserves the right to review photometric test.

D. Conduits: Conduit, including hangers and fittings, shall be installed where shown on the Contract Drawings and shall be in accordance with CSI Division 26 Section 260533, "Raceways & Boxes for Electrical Systems".

E. Fixture Wire: Fixture wire for lighting fixtures shall be as specified in CSI Division 26 Section 260519, "Low-Voltage Electrical Power Conductors & Cables."

F. All fixtures shall be installed for seismic requirements.

G. Luminaire support components: Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions under which lighting fixtures are to be installed, and substrate for supporting lighting fixtures. Notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer and with approval of Engineer.

3.2 INSTALLATION:

A. Install all luminaires, their components and associated supports, fittings, conduit, boxes, wiring and grounding conductors as called for in this section, as shown on the plans, as required and in accordance with the manufacturer's instructions and recommendations.

B. All fixtures shall be aligned and directed as shown or so as to illuminate the desired area properly. Fixtures shall be directly and rigidly mounted on their supporting structures using bolted connections. The conduit system shall not be used to support fixtures unless called for.

C. Where aluminum contacts concrete or dissimilar metal, separate contact surfaces with gasket, nonabsorptive tape or bituminous coating to prevent corrosion. Use stainless steel fasteners.

D. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:

1. Attached to masonry or structural members in walls using fasteners approved for application by lighting manufacturer.
2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing for bay fixtures for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

H. The minimum number of supports for surface mounted or suspended LED fixtures shall be one for each 4 ft of length plus one additional support: 4 ft-two (2) supports; 8 ft-three (3) supports; 12 ft-four (4) supports. Additional supports shall be provided if required. Attachment to structural steel shall be bolted type, anchors and inserts shall be installed as an integral part of structural system. Explosive or cartridge driven type inserts, anchors or supports are not approved.

I. All auxiliary steel, supports and brackets of all kinds for safety erecting the fixtures shall be furnished and installed in place by the Installer.

J. Where coordination with other equipment is necessary some departure from the locations shown may be permitted on approval of Engineer.

K. All lighting units when installed shall be set true and shall be free of leaks, warps, dents or other imperfections.

L. All fixtures shall be installed for seismic requirements.

3.3 GROUNDING:

A. Provide equipment grounding connections for interior lighting fixtures as indicated under CSI Division 26 Section 260526, "Grounding and Bonding for Electrical Systems".

B. All lighting fixtures shall be directly grounded to the equipment grounding system by means of a conductor of size not less than that required by NEC. If insulated, the ground conductor insulation shall be colored green.

3.4 FIELD QUALITY CONTROL:

A. The Installer is not responsible for the foot candles of illumination provided by the completed systems. However, if after the lighting is installed and in operation, any areas are noted which are obviously under or overlit, the Installer shall promptly advise the Engineer.

B. Fixtures shall be protected and maintained in good condition during construction. At the completion of the work, all fixtures shall be cleaned, inspected, and repaired, or replaced if damaged.

C. Perform an insulation resistance test on the lighting wiring before energizing and verify correct operation.

D. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

E. Luminaire will be considered defective if it does not pass operation tests and inspections.

F. Prepare test and inspection reports.

3.5 ADJUSTING AND CLEANING:

A. Clean interior lighting fixtures of dirt and construction debris upon completion of installation. Clean finger-prints and smudges from lenses. The contractor shall replace any defective or inoperative LED fixtures.

B. Protect installed fixtures from damage during remainder of construction period.

END OF SECTION 265119

SECTION 265613 - LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Poles and accessories for support of luminaires.

B. Related CSI Sections: The following sections contain requirements that relate to this Section:

1. Division 26, Section 260519, “Low Voltage Electrical Power Conductors and Cables”.
2. Division 26, Section 260529, “Hangers and Supports for Electrical Systems”.
3. Division 26, Section 260533, "Raceways and Boxes for Electrical Systems".
4. Division 26, Section 260543, “Underground Ducts and Raceways for Electrical Systems”.
5. Division 26, Section 260923, “Lighting Control Devices.”
6. Division 26, Section 262726, “Wiring Devices.”
7. Division 26, Section 265619, “LED Exterior Lighting”.
8. Division 26, Section 260548, “Vibration and Seismic Controls for Electrical Systems”.

1.2 DEFINITIONS:

A. EPA: Equivalent projected area.

B. Luminaire: Complete lighting fixture.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20 – 1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Provide poles recommended by lighting manufacturer. Include illustrations, specifications, schedules and material lists with quantities showing complete details of all proposed equipment.

C. Shop Drawings:

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of poles and pole accessories.
4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations.
5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
6. Method and procedure of pole installation. Include manufacturer's written installations.

D. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design.

E. Seismic Qualification Certificates: For poles, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on poles until right before pole installation. Handle poles with web fabric straps.

D. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.5 WARRANTY:

A. Refer to Form 818 Article 1.20 – 1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer agrees to repair or replace components of poles that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period: Five years from date of Certificate of Completion.
2. Warranty Period for Corrosion Resistance: Five years from date of Certificate of Completion.
3. Warranty Period for Color Retention: Five years from date of Certificate of Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with CTDOT Maintenance requirements, lighting manufacturers offering products that may be incorporated in the work are the following or an approved equal:

1. Valmont
2. United Lighting Standards.
3. Lithonia.
4. Hapco.
5. Cooper.

2.2 PERFORMANCE REQUIREMENTS:

B. Structural Characteristics: Comply with AASHTO LTS-6-M.

C. Dead Load: Weight of luminaire and its horizontal and vertical supports, supporting structure, applied according to AASHTO LTS-6-M.

D. Live Load: Single load distributed according to AASHTO LTS-6-M.

E. Ice Load: Load applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.

F. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

1. Basic wind speed for calculating wind load for poles.

    a. Wind Risk Category: I (Low, MRI = 300 yrs)
    b. Ultimate Design Wind Speed: 120 mph
    c. Directionality Factor: 0.85
    d. Gust Effect Factor: 1.14
    e. Minimum Design Life: 25 years.

G. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.

H. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.3 FIXTURE SUPPORT COMPONENTS:

A. Wind-Load Strength: Total support assembly, including pole, base, and anchorage, where used, to carry the fixtures, supports, and appurtenances at the indicated heights above grade without deflection or whipping.

B. Arm, Bracket, and Mount Materials: Finish bronze anodized.

C. Corrosion-resistant components compatible with the poles and fixtures that will not cause galvanic action at contact points. Provide mountings that will correctly position the luminaire to provide the indicated light distribution.

D. Pole Shafts: As shown on the lighting schedule.

E. Transformer Bases: Aluminum box-type assembly placed under the pole and used for wiring access or as a breakaway device.

F. Aluminum Poles: 6063-T6 alloy. Pole base: 356 or A356 alloy

G. Metal Pole Grounding Provisions: Welded 1/2-inch threaded lug.

H. Finish: Dark Bronze Anodized

I. Bolt Circle: Per Manufacturer’s Recommendation

J. Foundation: Per plan detail. Bolt circle per pole manufacturer recommendation.

K. Anchor bolts: Galvanized “J” bolt, sized in accordance with pole manufacturer’s recommendation.

2.4 GENERAL FINISH REQUIREMENTS:

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. 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.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine poles, luminaire-mounting devices and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

C. Examine roughing-in for foundation and conduit to verify actual locations of installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION:

A. Pre-Cast Foundations: Factory fabricated, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork per manufacturer's requirements.

B. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

3.3 POLE INSTALLATION:

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.

1. Fire Hydrants and Water Piping: 60 inches.
2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.

Trees: 15 feet from tree trunk.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer.

D. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
3. Install base covers unless otherwise indicated.
4. Use a short piece of 1/2 -inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 CORROSION PREVENTION:

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.

B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.5 GROUNDING:

A. Ground Metal Poles and Support Structures: Comply with requirements in CSI Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in CSI Division 26 Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL:

A. Poles shall be protected and maintained in good condition during construction. At the completion of the work, all poles shall be cleaned, inspected, and repaired, or replaced if damaged.

B. Perform the following inspections:

1. Inspect poles for nicks, mars, dents, scratches, and other damage.
2. System function tests.
3. Verify poles installed plumb.

END OF SECTION 265613

SECTION 265619 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes exterior lighting fixtures, LED lamps, drivers, and accessories for the complete outdoor lighting as shown on plans.

B. Related CSI Sections include the following:

1. Division 26, Section 260519, “Low Voltage Electrical Power Conductors and Cables”.
2. Division 26, Section 260529, “Hangers and Supports for Electrical Systems”.
3. Division 26, Section 260533, "Raceways and Boxes for Electrical Systems".
4. Division 26, Section 260543, “Underground Ducts and Raceways for Electrical Systems”.
5. Division 26, Section 260923, “Lighting Control Devices.”
6. Division 26, Section 262726, “Wiring Devices.”
7. Division 26, Section 265613, “Lighting Poles and Standards.”

C. Description:

1. The lighting system shall be compatible with the available voltage or as called for on the project plans. LED lighting, complete with drivers, shall be installed as shown on the plans.
2. Panelboards, fixtures, outlets, receptacles, switches and all other applicable lighting system components and details shall be as shown on the plans or as specified.
3. The plans show the location, number, size and type of lighting units and fixture schedule. All fixtures shall be UL listed.
4. Lighting plans are diagrammatic, with fixture outlets located approximately to scale but not dimensioned. Raceways are not generally shown. The Installer shall check lighting drawings against field conditions and the drawings of other disciplines for interferences and shall select and lay out locations for outlets and obtain approval for final locations from Engineer.
5. Fixtures to be installed in wet, damp, moist, corrosive or outdoor locations will be acceptable only when designed and manufactured specifically for outdoor, rugged, weatherproof services. Each part, component, nut, bolt, rivet and spring shall be made of materials of effective corrosion resistance or have been subjected to finishing treatment which will assure such resistance. Fixtures shall be certified by manufacturer for intended purpose.

1.2 DEFINITIONS:

A. CCT: Correlated Color Temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20 – 1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Include photometric curves, illustrations, specifications, schedules and material lists with quantities showing complete details of all proposed equipment.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Contract plans indicate the basis of design light fixtures. If the Contractor chooses to provide another manufacturer, a complete photometric lighting analysis showing all the illuminance levels, uniformity, lamp loss factor, luminaire depreciation, power densities, etc. shall be provided for review. The Department reserves the right to reject alternate luminaires based solely on photometric performance, lumen maintenance, and construction.

D. Maintenance Data: For interior lighting to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08-14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE:

A. Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 225, 250, and 410 as applicable to installation, and construction of exterior building lighting fixtures.

B. Comply with requirements of UL standards, including Standards 484A and B, pertaining to exterior lighting fixtures. Provide exterior lighting fixtures and components which are UL-listed and labeled.

C. Comply with ANSI C2, "National Electrical Safety Code."

1.5 SEQUENCING AND SCHEDULING:

A. Coordinate with other work including conductors and cable, raceways and boxes, to properly interface installation of interior lighting fixtures with other work.

1.6 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. 1 LED driver per fixture type

1.7 WARRANTIES:

B. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

C. Warranty period: 5 years from the issuance of Certificate of Compliance for LED fixture, factory-installed electrical component system; a minimum of two years for other luminaire components. The warranty shall cover both parts and labor for the complete warranty period.

D. Replace defective and burned out light bars or drivers for a period of one year following the date of Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Three for each fixture type, as specified on the lighting fixture schedule, no equals shall be permitted.

2.2 MATERIALS:

A. General:

1. Lighting fixtures (luminaires) shall be complete with mounting brackets and hardware, led modules, drivers, installation accessories, fixture wire, and all accessories as required, as specified in the Fixture Schedule, as shown on the Contract plans and as required by NEC.

1. All LED fixtures shall have the following standard options:
   a. 4000K color temperature

b. Voltage and phasing as indicated on plans, and panel schedules.
c. Optics: Full cutoff
d. 10kV minimum surge suppression
e. Exterior pole lighting: Occupancy sensor and dimming devices shall be wet location rated and supplied by the contractor for use with the LED pole lighting. Dimming controls shall be installed and mounted per manufacturer's installation instructions.
f. All light fixtures shall qualify for possible utility rebate/incentives.

B. Lighting Fixture Schedule: no equals shall be permitted; contractor shall use the most recent version and or generation of the fixtures below.

NAME	BASE DESCRITPION	Min Lumen package	BASIS OF DESIGN 1	BASIS OF DESIGN 2	BASIS OF DESIGN 3
D	LED FULL CUTOFF WALL-PACK LUMINAIRE; BRONZE FINISH, FORWARD THROW TYPE 4 DISTRIBUTION	**6,000**	**LITHONIA** WST LED	**RAB** WPLED	**PHILIPS** 101L
DS	LED FULL CUTOFF WALL-PACK LUMINAIRE; BRONZE FINISH, FORWARD THROW, TYPE 4 DISTRIBUTION, LOW WATTAGE	**3,000**	**LITHONIA** WST LED	**RAB** WPLED	**PHILIPS** 101L
L2	LED COBRA - ROADWAY LUMINAIRE - WIDE ROADWAY DISTRIBUTION. IES TYPE 2M, FULL CUTOFF, MAST ARM, BRONZE FINISH	**10,400**	**LITHONIA** DSX1 40C	**AEL** ATBO 30B	**PHILIPS** RFM
L3	LED COBRA - ROADWAY LUMINAIRE - FORWARD THROW DISTRIBUTION. IES TYPE III, FULL CUTOFF, MAST ARM, BRONZE FINISH	**11,000**	**LITHONIA** DSX1 40C	**AEL** ATBO 30B	**PHILIPS** RFM
GI	FLAG POLE FIXTURE; COMPACT FLOOD, LED, 208V, WIDE FLOOD RECTANGULAR. STANCHION MOUNT, BRONZE FINISH. INCLUDE 24" BRONZE FINISH STANCHION	**15000**	**LITHONIA** DSXF3 LED	**RAB** FXLED 125W	**PHILIPS** FL150
	SALT SHED				
SA	LED WET LOCATION, CORROSION RESISTANT LUMINAIRE, MARINE TYPE, PENDANT MTD., WITH SAFETY CHAIN ASSEMBLY & 3' CORD, PRISMATIC GLASS CLOSED BOTTOM.	**18000**	**HOLOPHANE** PLED2	**RAB** FALCOR230W	**KENALL** EPLB22
SB	LED FULL CUTOFF WALL-PACK LUMINAIRE WITH DIE-CAST ALUMINUM HOUSING PAINTED WITH POWDER COAT FINISH AND IP65 RATING. FORWARD THROW DISTRIBUTION	**8000**	**LITHONIA** CSXWLED	**RAB** WPLED	**PHILIPS** 101L32L1000
FL	HEAVY DUTY FLOOD LIGHT LUMINAIRE, LED WET LOCATION, MEDIUM FLOOD, BRONZE FINISH, & FIXTURE BRACKET	**17000**	**LITHONIA** DSXF3	**RAB** FXLED	**PHILIPS** FL150

C. Conduits: Conduit, including hangers and fittings, shall be installed where shown on the Contract plans and shall be in accordance with CSI Division 26 Section 260533, "Raceways & Boxes for Electrical Systems."

D. Refractors and Reflectors: All glassware and plastic shall be uniform, free from defects and photometrically tested for distribution by an independent testing laboratory. Plastic diffusers shall be of new virgin-acrylic plastic material. Designer reserves the right to review photometric test.

2.3 FINISH:

A. Metal Parts: Manufacturer's standard finish except as otherwise indicated. Finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters, and similar defects. Remove fixtures and accessories showing evidence of corrosion or finish failure during Project warranty period and replace with new items.

B. Other Parts: Manufacturer's standard finish except as otherwise indicated applied to factory-assembled and -tested luminaire before shipping. Match finish process and color of pole or support materials.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions under which lighting fixtures are to be installed, and substrate for supporting lighting fixtures. Notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer and with approval of Engineer.

3.2 INSTALLATION:

A. Install all luminaires, lamps and associated supports, fittings, conduit, boxes, wiring and grounding conductors as called for in this section, as shown on the plans, as required and in accordance with the manufacturer's instructions and recommendations.

B. Prior to the issuance of the Certificate of Compliance, thoroughly clean the luminaires, LED lens assemblies.

C. All fixtures shall be aligned and directed as shown or so as to illuminate the desired area properly. Fixtures shall be directly and rigidly mounted on their supporting structures using bolted connections. The conduit system shall not be used to support fixtures unless called for.

D. Fixtures shall be mounted plumb, level and in straight lines. Rows of fixtures shall be installed accurately as to line and level. Fastenings and supports shall be firmly set so that the fixtures will not be distorted by handling incident to normal maintenance. All parts including lamps shall be secured to prevent falling or dislocation.

E. Lighting fixtures shall be positioned to clear all obstructions.

F. All auxiliary steel, supports and brackets of all kinds for safety erecting the fixtures shall be furnished and installed in place by the Installer.

G. Where coordination with other equipment is necessary some departure from the locations shown may be permitted on approval of Engineer.

H. All lighting units when installed shall be set true and shall be free of leaks, warps, dents or other imperfections.

I. All lighting fixtures shall be directly grounded to the equipment grounding system by means of a conductor of size not less than that required by NEC. If insulated, the ground conductor insulation shall be colored green.

J. Taps and splices shall be made with insulated wire nut connectors of the setscrew or spring type or with indent compression type connectors. Solid wire shall be terminated at screw type connections by looping around the terminal screw. At panelboards, solid wire may be terminated using screw type pressure terminals; stranded wire may be terminated using saddle type pressure terminals.

K. All fixtures shall be installed for seismic requirements.

3.3 GROUNDING:

A. Provide equipment grounding connections for interior lighting fixtures as indicated under CSI Division 26 Section 260526, "Grounding and Bonding for Electrical Systems."

3.4 FIELD QUALITY CONTROL:

A. The Installer is not responsible for the foot candles of illumination provided by the completed systems. However, if after the lighting is installed and in operation, any areas are noted which are obviously under or overlit, the Installer shall promptly advise the Engineer.

B. Fixtures shall be protected and maintained in good condition during construction. At the completion of the work, all fixtures shall be cleaned, inspected, and repaired, or replaced if damaged, and a complete set of new incandescent lamps shall be installed.

3.5 ADJUSTING AND CLEANING:

A. Clean lighting fixtures of dirt and construction debris upon completion of installation. Clean finger-prints and smudges from lenses.

B. Protect installed fixtures from damage during remainder of construction period.

C. Adjust aim-able fixtures to provide required light intensities.

END OF SECTION 265619

SECTION 270000 - PREMISES TELEPHONE WIRING

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes telephone components, data system, and coordination with telephone utilities (Frontier) and the Telecommunications Department.

B. Related CSI Sections include:

1. Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables."
2. Division 26 Section 260533, "Raceways and Boxes for Electrical Systems."
3. Division 26 Section 260543, "Underground Ducts and Raceways for Electrical Systems"
4. Division 26 Section 262726, "Wiring Devices."

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR SUBMITTALS.

B. Product Data: Manufacturer's catalog cuts and installation instructions for telephone communication equipment.

C. Quality Assurance Submittals:

1. Testing and Inspections reports performed by an independent agency.

1.3 QUALITY ASSURANCE:

A. Testing Agency Qualifications: Independent testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the NETA and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the NETA or the NICET to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70

1.4 COORDINATION:

A. Telephone System Service: The Contractor is responsible for the coordination of telephone service with the Department telecommunications personnel and Frontier. This includes the service connections to the facility by the utility company. No cost is anticipated from Frontier

B. Telephone System Wiring: The Contractor shall install voice/data communications outlets as shown on the plans and terminate at new patch panels for voice and panel for data. All final cross connections by the Contractor under the supervision of Department telecommunications personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, all the equipment shall be the product of the utility company, or an approved equal.

2.2 TELEPHONE SWITCH MOUNTING AREA:

A. Installer shall provide a completed telephone conduit system along with plywood for mounting telephone/communication equipment, including all wiring and terminations.

2.3 TELEPHONE CONDUIT SYSTEM:

A. The Contractor shall furnish and install a complete telephone conduit system as shown on the plans. All communication and data conductors shall be installed in conduit unless otherwise noted.

B. Empty conduit shall contain a pull wire, Greenlee No.430 poly pull line, or an approved equal.

2.4 COMMUNICATION OUTLETS:

A. All outlets shall be in accordance with the communication standard EIA/TIA-568B.

B. Voice/Data Outlets: No approved equal will be accepted. All outlets labeled on plans as communication outlets shall be installed as follows:

1. All voice/data outlets shall be Siemon Cat6 Z6-XX Z-MAX 6 UTP module, hybrid (flat/angled).
2. Two outlets shall fit a single gang opening with one white outlet for voice cable and one orange outlet for data cable. Voice jack shall have a telephone headset icon to distinguish Voice and computer mouse icon to distinguish Data.
3. Install compatible stainless steel faceplate

C. Cat 6A Voice/Data Outlets: No approved equal will be accepted. All outlets labeled on plans as communication outlets shall be installed as follows:

1. All voice/data outlets shall be Siemon Cat6A Z6A-XX Z-MAX 6A UTP module, hybrid (flat/angled).
2. Two outlets shall fit a single gang opening with one white outlet for voice cable and one orange outlet for data cable. Voice jack shall have a telephone headset icon to distinguish Voice and computer mouse icon to distinguish Data. Jacks for the wireless access points shall not include an icon.
3. Install compatible stainless steel faceplate.
4.

2.5 PATCH PANELS:

A. Patch Panels:
1. Cat 6 Patch panels: Patch panels shall be Cat6 compliant, either a 24 port unloaded Siemon MX-PNL-24 or a 48 port unloaded Siemon MX-PNL-48, or approved equals.
2. Cat 6A Patch panels: Patch panels shall be Cat6A compliant, either a 24 port unloaded Siemon MX-PNL-24 or a 48 port unloaded Siemon MX-PNL-48, or approved equals.

2.6 CABLING:

A. Cabling shall comply with the requirements included in CSI Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install communication outlets, conduit systems wiring, and plywood mounting panels as indicated, in accordance with the drawings and with recognized industry practices; ensure systems comply with installation requirements CSI Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

B. The Installer shall provide for the installation of underground conduit and cable as detailed in CSI Section 260543, "Underground Ducts and Raceways for Electrical Systems."

C. Extent of interior telephone system work includes communication terminal board, conduits, wiring system, and communication outlets using electrical products complying with requirements of applicable sections and in accordance with the telecommunication wiring standards with the EIA/TIA-568 and EIA/TIA-569 specifications.

D. Two cables shall be installed between the communication outlet box and communication terminal board.

E. Each cable shall be identified on both ends using wire tags. The cable shall have 18" excess length on the communication outlet side and 36" excess at the terminal board side.

F. Contractor shall make all final phone connections under the supervision of Department telecommunications personnel. The Contractor shall run all phone and data cable as directed.

G. Support cables above accessible ceilings to keep them from resting on ceiling ties. Use spring metal clips or plastic cable ties to support cables from structure or ceiling suspension system. Include bridle rings or drive rings. Cable shall be run in conduit in the bay areas. Use c-channels and conduit clamps to support conduit from structure or ceiling trusses in the bay areas.

3.2 LABELING:

A. All Communication Outlets, and Patch Panels, are to be machine labeled in contrasting colors with a unique location number and the designation (voice or data).

B. Handwritten labels are not acceptable.

3.3 TERMINATIONS:

A. All Voice and Data Cables shall be terminated at the Terminal Board located in the Communications Room as follows:

1. Voice Cables shall be terminated in CAT 6 patch panels. Spare capacity of 20 percent is required.
2. Data Cables shall be terminated in CAT 6 patch panels. Spare capacity of 20 percent is required.
3. Wireless Access point Data cable shall be terminated in CAT 6A patch panels. Spare capacity of 20 percent is required.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect communication conductors for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test communication cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection panels. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 270000

SECTION 274000 - BASE STATION RADIO ANTENNA SYSTEM

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes a complete base radio antenna system.

B. The complete system shall be accepted by the Departments' Radio Communications Supervisor, Mr. Nicholas Carlone of the Rocky Hill Laboratory, at (860) 258-0376.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR SUBMITTALS.

B. Product Data: Manufacturer's catalog cuts and installation instructions.

C. Shop Drawings: Indicate all electrical characteristics and connection requirements. Include the following:

1. Indicate layout of equipment, component interconnecting wiring, wiring diagrams of field wiring between antenna and base radio.
2. Details of manufactures recommended foundation, tower support sections and assemblies, tower sections, mounting assembly.
3. Rated load information including; Maximum antenna load at 105 miles per hour with ½ inch ice rating.
4. Composite wiring and schematic diagrams of the complete system as proposed to be installed.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Field Reports: Indicate installation is complete according to specified requirements.

1.3 SYSTEM DESCRIPTION:

A. General: The base station radio antenna system shall be a complete antenna system for broadcast transmission and reception.

B. Functional Performance: Components and system features and functions shall include, but are not limited to, the following:

1. Antenna cut to Conn DOT frequency of 47.24 MHz or as specified by the radio lab.

1.4 QUALIFICATIONS:

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum 3 years documented experience.

B. Supplier: Authorized distributor of specified manufacturer with minimum 3 years documented experience.

C. Installer: Authorized installer of specified manufacturer with service facilities within 100 miles of Project. Installer shall have 20 years of experience with an average of 3 installations a year.

1.5 REGULATORY REQUIREMENTS:

A. Furnish products listed and classified by UL or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

B. Conform to requirements of FCC.

C. Conforms to the requirements of - Motorola Standard and Guidelines for Communication Sites R-56.

PART 2 - PRODUCTS

2.1 COMMUNICATION SUPPORT STRUCTURE:

A. 40-foot self-supporting tower constructed of high-strength steel mounted on 5 foot fixed base section, Rohn Model 65G or approved equal.

B. The high strength steel support structure shall be designed to withstand 105-mph basic wind speed per ANSI/EIA-222-E with 1/2-inch radial ice.

C. Finish; The tower sections, as well as all hardware, shall be completely hot dip galvanized, both inside and out after fabrication.

2.2 COMMUNICATION SUPPORT STRUCTURE FOUNDATION:

A. Foundation shall be designed in accordance with ANSI/EIA-222-E, “STRUCTURAL STANDARDS FOR STEEL ANTENNA TOWERS AND ANTENNA SUPPORTING STRUCTURES”. The design of the structure shall also take into account the type of soil found at the proposed structure location.

B. Installer shall provide structure manufacturer with soil boring information, obtained from boring taken at proposed structure location. The installer shall be responsible to take the subject boring.

C. Installer shall construct foundation per structure manufacturer's recommendation. Foundation shall be capable of supporting structure designed for 25 square foot antenna load, 110-per-hour wind and ½ inch ice rating.

D. Anchor bolts shall meet or exceed the requirements of ASTM A354 grade BC.

E. Maximum size of aggregate shall not exceed ¾ inch.

F. Reinforcement shall be deformed steel and conform to the requirements of ASTM A615 grade 60 unless otherwise noted. Splices in reinforcement shall not be allowed unless otherwise indicated.

G. Reinforcement cages shall be braced to retain proper dimensions during handling and throughout placement of concrete.

H. Minimum concrete cover for reinforcement shall be three inches unless otherwise noted.

I. Pole foundation drawings with foundation details shall be sealed by a Professional Engineer licensed in the State of Connecticut. The drawings shall be provided to the Designer for review.

2.3 ANTENNA:

A. The antenna shall be Aluminum, omnidirectional, Kreco Co-Axial Antenna. Model No. Model Co-36AN at 47.24 Megahertz or approved equal.

2.4 CABLE and CABLE ACCESSORIES:

A. 1/2-inch coaxial transmission cable which shall be attached to the pole with snapping cable clamps, Butterfly Hangers, BUG 12 or approved equal

B. Cable for tone remote stations: CATIGORY 6: Cabling shall comply with the requirements included in CSI Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

C. Cable 4-Way Entry port into building Site Pro 1, E1199 or approved equal

D. Cable hangers from ice bridge, Site Pro 1, 12HC Clip Hanger, or approves equal.

2.5 CONNECTORS:

A. Connectors, Andrews Corp. type "N" male L44PW-P1, and bottom type "N" female ,L4TNK-PS Andrew Corp, approved equal.

B. Ground kits, Clip On Ground Kits, Site Pro 1, GK-C12 or approved equal. Install one from the tower to the ice bridge, one on the outside of the building at the entry point, and one at the radio equipment.

C. Ground Bar, mounted to exterior of building - Site Pro 1, MG406U-K or approved equal.

D. Ground Bar on tower - Site Pro 1, MG406U-K or approved.

E. Polyphaser, Install one on the inside of the building at the entry point - IS-50NX-CO or approved equal.

2.6 SIDE ARM ASSEMBLY:

A. Shall be designed for an allowable antenna loading of 90-lbs. lateral thrust.

2.7 OVERHEAD BRIDGE STRUCTURE:

A. Overhead Ice Bridge Structure: Type in accordance with manufacturer recommendations of the size required by the plans. Self-supported on the side closest to the antenna, and thru bolted to building. Each supporting post shall be grounded per Motorola R-5.

2.8 Radio Equipment

A. Low Band Radio – Kenwood, TK-690H, Type-3, Wide, Dash Mount or approved equal.

B. Tone Remote - Gai-Tronics IPE2500A-MLS , 4-Channel, or approved equal

C. Tone Remote Adapter - Telex DSP-223 Tone Remote Adaptor, or approved equal

D. Equipment Rack - Middle Atlantic SBX Series EWR Series Rack, EWR-8-17SD, Fixed Wall Mount with Lockable Door. Or approved equal

E. Rack Mount Power Supply – Rack Mount 6 Outlet Rear Facing Power Strip, with Surge Protector

F. DC inverter – Samlex Rack Mount Power Supplied, 60 Amps, or approved equal

G. Surge Protected UPS - APC Smart-UPS 1500, Rack Mounted or approved qual.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Coordinate installation with the Department's Radio Communications Supervisor;
NAME: Nicholas Carlone
EMAIL: Nicholas.Carlone@ct.gov,
NUMBER: 860-258-0376

B. Install in accordance with manufacturer's instructions.

C. Transmission cable shall not be spliced at any given point. The transmission cable shall run continuous between antenna and base radio. No bend in the cable shall be less than 6" bending radius.

D. 1/2" transmission cable shall be terminated at the low band radio in the Communications Room with Type-N Connection.

E. Provide protection for exposed cables where subject to damage.

F. Support cables above accessible ceilings to keep them from resting on ceiling tiles. Use spring metal clips or plastic cable ties to support cables from structure or ceiling suspension system. Include bridle rings or drive rings. Cable Runs of the ½" transmission cable in other areas or surface mounted shall be protected with conduit, or approved equal housing

G. Use suitable cable fittings and connectors.

H. Ground and bond equipment and circuits in accordance with CSI Division 26 Section 260526, "Grounding and Bonding for Electrical Systems" and Motorola Standard and Guidelines for Communication Sites R-56.

3.2 FIELD QUALITY CONTROL:

A. Include supervising final wiring connections, inspection and adjusting of completed installation, and systems demonstration.

B. Certify that installation is complete and performs according to specified requirements.

C. For final electrical test of base station radio antenna system, contact Nicholas Carlone
EMAIL:Nicholas.Carlone@ct.gov,
NUMBER: 860-258-0376

END OF SECTION 274000

SECTION 275116 - PUBLIC ADDRESS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes a complete public address system.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

1. Spare Parts: Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings:

1. Indicate all electrical characteristics and connection requirements. Indicate layout of equipment mounted in racks and cabinets, component interconnecting wiring, and wiring diagrams of field wiring to speakers and remote input devices.
2. Composite wiring and schematic diagrams of the complete system as proposed to be installed (typical diagrams will not be acceptable).

D. Quality Assurance Submittals:

1. Test Reports: Indicate satisfactory completion of each test recommended by the manufacturer.
2. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.
3. Manufacturer's Field Reports: Indicate installation is complete and system performs according to specified requirements.
4. Record actual locations of speakers, control equipment, and outlets for input/output connectors.

E. Maintenance Data: Name, address, and telephone number of nearest fully equipped service organization to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.3 SYSTEM DESCRIPTION:

A. General: The public address system shall be a complete system for amplifying sound signals from the telephone network and distributing them to loudspeakers at various locations. The system includes the Page control unit, speaker amplifiers, cables in conduit, and loudspeakers.

B. Functional Performance: Components and system features and functions shall include, but are not limited to, the following:

1. Public address system for voice.
2. Telephone System Integration control to make an announcement to speaker stations.

1.4 QUALIFICATIONS:

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

B. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.

C. Installer: Authorized installer of specified manufacturer with service facilities within 100 miles of Project.

1.5 REGULATORY REQUIREMENTS:

A. Furnish Products listed and classified by UL or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

B. Conform to requirements of the FCC.

1.6 COORDINATION:

A. Coordinate speaker locations with lighting, occupancy sensors, HVAC diffusers and grilles, and any other electrical/mechanical equipment.

B. Speakers located in designated areas shall have a local volume control as shown on the Contract Plans.

C. Telephone System connections: The Contractor is responsible for the coordination of telephone connections to the page control unit with the Department telecommunications personnel. The contractor shall make any necessary final telephone connections to the

page control unit under the Departments telecommunications supervision after the building is occupied and telephones are installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Valcom
2. Peavey
3. Quam

2.2 PAGE CONTROL UNIT:

A. Valcom V-2001A or approved equal
   1. one zone paging
   2. Power requirements: 120 VAC, 60 Hz.
   3. Up to 20 one-way speakers
   4. Electronic Key System (C. O. Line Position)
   5. PABX (Loop or Ground Start Trunk)
   6. 600 Ohm Page Port equipped with contact closure and DTMF dialing capability.
   7. Dedicated single line telephone(s)
   8. UL Listed
   9. Output Impedance:
      a. 8 Ohms (1 way)
   10. Output level:
      a. -10dBm (1 way)
      b. 1 Watt (Talkback)
   11. DC Output: -24VDC at 1 Amp
   12. Input Impedance: 600 Ohms

2.3 CABLES:

A. Cables shall comply with the requirements included in CSI Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

2.4 SPEAKERS:

A. Ceiling Speaker: Valcom V-9022A-2 or approved equal

1. 8" Speaker assembly with speaker, amplifier and volume control mounted in 2' x 2' grille with integral backbox.
2. 1 watt amplifier built-in
3. 5 oz. (142 g) ceramic magnet.
4. Impedance: 45 ohms
5. Steel housing with a white baked on acrylic enamel finish
6. Meets or exceeds ASTM E84 flame & smoke test (UL181)
7. OUTPUT
   a. Rating: > 96 dB @ 4'
   b. Signal/noise ratio: -70 dB
8. Frequency response: 80 Hz to 15 kHz
9. Power requirement: 50 Ma @ 24 Vdc
10. Four seismic tabs provided for additional mounting integrity

B. Weatherproof Horn: Valcom V-1030C or approved equal

1. Self-Amplified
2. Wattage: 5 Watt
3. Input Impedance: 1000 Ohms nominal
4. Input Level: -15dBm to +10dBm
5. Current at -24VDC: 300mA
6. Built-in volume control

C. Power Supply for Horns: Valcom VP-4124D or approved equal
1. Input:
   a. 100-240VAC, 50/60Hz
   b. IEC-320-C14 input receptacle
   c. Input Current (@115V, 60Hz, Rated Output Load): 0.93A
   d. AC Apparent Power 107.0VA
   e. Level VI efficiency
2. Output:
   a. 24VDC, 4A Regulated
   b. 500mm cable
   c. positive (mating wire assembly for Class 2 wiring included)
3. UL listed

D. Volume Control: Velcom V-1092 or approved equal

1. Stainless steel faceplate

2.5 CONNECTING BLOCKS: Siemon S66 or approved equal

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install in accordance with manufacturer's instructions.

B. Splice cable only in accessible junction boxes or at terminal block units

C. Leave 18 inches excess cable at each termination at each component.

D. Provide protection for exposed cables where subject to damage.

E. Support cables above accessible ceilings to keep them from resting on ceiling ties. Use spring metal clips or plastic cable ties to support cables from structure or ceiling suspension system. Include bridle rings or drive rings. Cable shall be run in conduit in the bay areas. Use c-channels and conduit clamps to support conduit from structure or ceiling trusses in the bay areas.

F. Use suitable cable fittings and connectors.

G. Ground and bond equipment and circuits in accordance with CSI Section 260526, “Grounding and Bonding for Electrical Systems.”

H. Secure seismic cable to seismic sabs on speaker units in accordance to local code and manufactures instructions.

3.2 FIELD QUALITY CONTROL:

A. Measure and record sound power levels at designated locations.

B. Include supervising final wiring connections, inspection and adjusting of completed installation, and systems demonstration.

C. Certify that installation is complete and performs according to specified requirements.

3.3 ADJUSTING:

A. Adjust devices and wall plates to be flush and level.

3.4 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 subsection 3 for additional information.

B. Conduct a walking tour of Project. Briefly describe function, operation, and maintenance of each component.

END OF SECTION 275116

SECTION 282300 - VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 SUMMARY:

A. This Section includes video surveillance system consisting of cameras, data transmission wiring, and a control station with its associated equipment.

B. Video surveillance system shall be integrated with monitoring and control system specified in this section.

1.2 DEFINITIONS:

A. AGC: Automatic gain control.

B. CCD: Charge-coupled device.

C. MPEG: Moving picture experts group.

D. NTSC: National Television System Committee.

E. NVR: Network Video Recorder.

F. UPS: Uninterruptible power supply.

G. POE: Power over Ethernet

1.3 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

C. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

1. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
2. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
3. Wiring Diagrams: Power, signal, and control wiring, and grounding.

D. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

E. Supports: Camera and monitor supporting equipment, accessories, and components will be installed in accordance with CSI Division 26 Section 260529, "Hangers and supports for Electrical Systems." Include the following:

F. Field quality-control test reports.

G. Operation and Maintenance Data: For cameras, power supplies, monitors, video switches, and control-station components to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08-14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE:

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NECA 1.

C. Comply with NFPA 70.

D. Electronic data exchange between video surveillance system shall comply with SIA TVAC.

1.5 PROJECT CONDITIONS:

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 1 enclosures.
2. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250,

winds up to 110 mph and snow cover up to 24 inches (610 mm) thick. NEMA 250, Type 4X enclosures.

3. Corrosive Environment: System components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones. NEMA 250, Type 4X enclosures.

1.6 WARRANTIES:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to manufacturers specified.

2.2 BULLET CAMERAS:

A. Available Manufacturers:

1. Avigilon.
2. Bosh Security Systems.
3. Panasonic Security Systems.

B. Camera: Colored Camera designed for high-abuse locations, with a weathertight surface mounting, impact-resistance powder coated aluminum body.

1. Suitable for exterior environment (NEMA 4X), rated for continuous operation in ambient temperatures of minus 40 to plus 122 deg F dry bulb and up to 80 percent relative humidity.
2. Comply with UL 60950.
3. Power Source: PoE IEEE802.3af Class 3 Compliant
4. Active Pixels: 2048 (H) x 1536 (V).

C. Provide wall mounting bracket type matched to items supported and mounting conditions.

2.3 NETWORK VIDEO RECORDER:

A. Available Manufacturers:

1. Avigilon
2. Bosh Security Systems
3. Panasonic Security Systems

B. The NVR shall be housed in a shelf mount with all suitable connectors available on the back panel. It shall have a screened steel case construction and be finished in black color. It shall be operated indoors in a temperature range not to exceed 32 to 104° F (0 to 40° C) and a humidity range not to exceed 0 to 90% relative, in a non-condensing atmosphere. The workstation shall employ a Universal Voltage Power Supply requiring 105 - 240 VAC @ 50 - 60 Hz.

C. The NVR shall be capable of recording but shall not be set up to record.

D. HDMI video out for HD video monitoring

E. Network Video Management Software

F. Includes a Core or Standard license with camera channel licenses for each port

2.4 MONITORS:

A. Available Manufacturers:

1. Dell.
2. ADEMCO Video; Pittway Corporation.
3. Bosch Security Systems, Inc.
4. Toshiba Corporation; Surveillance products

B. Color display:

1. Screen Size (Diagonal Dimension): 24”
2. Resolution: 1920x1200 @ 60hz
3. Minimum Front Panel Devices and Controls: Power switch, power-on indicator, and brightness, contrast, color and tint controls.

2.5 SIGNAL TRANSMISSION COMPONENTS:

A. Cable: Cat 6. Cables shall comply with manufacturer's recommendations. Refer to CSI Division 26 Section 260519, "Low -Voltage Electrical Power Conductors and Cables".

2.6 SYSTEM REQUIREMENTS:

A. Video signal format shall comply with the NTSC standard digital video, progressive.

B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.

PART 3 - EXECUTION

3.1 WIRING:

A. Wiring Method: Install cables in raceways and as otherwise indicated. Conceal raceways and wiring except in unfinished spaces.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

C. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.2 VIDEO SURVEILLANCE SYSTEM INSTALLATION:

A. Install cameras level and plumb.

B. Install cameras as shown on plans. Change type of mounting to achieve required clearance.

C. Install power supplies and other auxiliary components at control stations, unless otherwise indicated.

D. Identify system components, wiring, cabling, and terminals according to CSI Division 26 Section 260553, "Identification of Electrical Systems."

3.3 FIELD QUALITY CONTROL:

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

C. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video surveillance equipment for acceptance and operational testing as follows:

   1. Verify operation of auto-iris lenses.
   2. Set and name all preset positions; consult Owner's personnel.
   3. Verify operation of control-station equipment.

D. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 calendar days. Provide a minimum of 10 calendar days' notice of test schedule.

E. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

F. Remove and replace malfunctioning items and retest as specified above.

G. Record test results for each piece of equipment.

H. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.4 ADJUSTING:

A. Occupancy Adjustments: When requested by the Engineer within 12 months of the issuance of the Certificate of Compliance, the Contractor shall provide on-site assistance in adjusting system to suit actual occupied conditions and to optimize performance of the installed equipment. Tasks shall include, but are not limited to, the following:

   1. Check cable connections.
   2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.
   3. Adjust all preset positions; consult Owner's personnel.
   4. Recommend changes to cameras, lenses, and associated equipment to improve Owner' utilization of video surveillance system.
   5. Provide a written report of adjustments and recommendations.

B. The Contractor shall provide one visit to the Project Site outside of normal occupancy hours for this purpose at no additional cost to the Department.

3.5 CLEANING:

A. Clean installed items using methods and materials recommended in writing by manufacturer.

B. Clean video surveillance system components, including camera-housing windows, lenses, and monitor screens.

3.6 TRAINING:

A. Refer to Form 818 Article 1.20-1.08.14 Subsection 3 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain video surveillance equipment.

4. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.
5. Demonstrate methods of determining optimum alignment and adjustment of components and settings for system controls.
6. Review equipment list and data in maintenance manuals.
7. Conduct a minimum of two hours' training as specified in instructions to Owner's employees

END OF SECTION 282300

SECTION 283111 – DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY:

A. Furnish and install a complete fire alarm system as described herein using addressable control panel and as shown on the plans. The fire alarm system shall be wired, connected, and left in first-class operating condition. The system shall use addressable loop initiating device circuits with individual supervision. All wiring, connections to devices, outlet boxes, junction boxes, and all other necessary material for a complete operating system shall be included. All conductors for the fire alarm system shall be routed in conduit.

B. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component. The entire system shall bare the appropriate UL listings.

1.2 SYSTEM DESCRIPTION:

A. Fire alarm system shall be FM Global approved and shall be installed in accordance to FM Global Data Sheet 5-40 and 5-48.

B. The System shall consist of initiating devices and indicating appliances wired to the fire alarm panel. The System shall generate audible alarms throughout all signal horns and signal lamps shall flash continuously throughout the building at the activation of any of the fire detectors, until manually reset. A signal shall be generated to report the troubled condition to the respective authorities.

1.3 OPERATION:

A. The System alarm operation subsequent to the alarm activation of any manual station or automatic detection device shall be to cause an alarm condition at the central panel. Central panel shall contain a dialer to alert local fire authorities in the event of alarm activation.

B. The alarm and/or trouble condition shall be indicated on the remote 80-character annunciator panel. Indicate the device in alarm on the fire control panel and the remote annunciator.

C. Alarm horns and indicating appliances shall be activated by the alarm condition at the central panel. Weatherproof fire alarm horn with strobes shall be installed in such a manner that it is visible from the access road.

D. The operation of the system shall be in compliance with all applicable fire alarm codes.

1.4 SUPERVISION:

A. The system shall contain Class 'A' independently supervised initiation circuits so a fault in any one area shall not affect any other zone. The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit. Wiring for the signal line circuit shall be twisted unshielded and support a minimum wiring distance of 12,500 feet. Number and size of conductors shall be as recommended by the manufacturer of the fire alarm system but not less than 18 AWG for initiating device circuits and signaling line circuits. All fire alarm system conductors shall be installed in conduit, unless otherwise noted.

B. There shall be independently supervised and independently fused indicating appliance circuits for alarm horns and flashing alarm lamps.

C. All auxiliary manual controls shall be supervised so that all switches must be returned to the normal automatic position to clear system trouble.

D. Each independently supervised circuit shall indicate on the 80-character display "Trouble" to indicate disarrangement conditions per circuit. Each junction box capacity shall be 40 percent greater than that required for associated fire alarm system wires. Each junction box shall be painted fire alarm red and identified with white markings "FIRE ALARM SYSTEM."

E. The incoming power to the system shall be supervised so that any power failure shall be audibly and visually indicated at the control panel. A green "POWER ON" LED shall be displayed continuously while incoming power is present.

F. The system batteries shall be supervised so that disconnection of a battery shall be audibly and visually indicated at the control panel. Final connections between equipment and wiring system shall be made under supervision of the manufacturer's representative. Fire alarm equipment shall be flush to surface wherever possible.

G. The System Expansion Modules connected by ribbon cables shall be supervised for module placement. Should a module become disconnected from the CPU the system trouble indicator shall illuminate and audible trouble signal shall sound.

H. Wires for local fire alarm system shall be color-coded to correspond with manufacturers' wiring schematics submitted with shop drawings, sized as recommended by the fire alarm system manufacturer and installed in conduit. Combined cross sectional area of conductors or cables shall not exceed percentage of fill specified in Table 1, Chapter 9 of NEC. Conduit size shall be coordinated with fire alarm manufacturer.

I. The Fire alarm system shall be able to communicate with the DOT ADT service for offsite monitoring.

1.5 POWER REQUIREMENTS:

A. The Fire Alarm Control Panel shall receive 120 VAC power (primary source of power as noted on the plans) via a dedicated circuit breaker. The secondary source of power (standby source) is a generator in conjunction with the fire alarm system standby battery and charger.

B. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of 24 hours with 5 minutes of alarm indication at the end of this period. The system shall automatically transfer to the emergency diesel generator in conjunction with standby batteries upon power failure. All battery charging and recharging operations shall be automatic. Batteries, once discharged, shall recharge at a rate to provide a minimum of 70% capacity in 12 hours.

C. All circuits requiring system-operating power shall be 24VDC and shall be individually fused at the control panel.

1.6 SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Manufacturer's catalog sheets, specifications, and installation instructions.

1. Include name, address, and telephone number of in-state supplier of spare parts. No out-of-state suppliers shall be permitted.

C. Shop Drawings: CADD generated composite wiring and schematic diagrams, produced and stamped by Supplier, of the complete system as proposed to be installed. Include battery-size calculations sheet.

D. Quality Assurance Submittals:

1. Name, address and telephone number of nearest fully equipped service organization.
2. Test Reports: Final System test report.
3. Certificate: Affidavit, signed by the approved supplier and notarized, certifying that the system meets the Contract requirements and is operating properly.

E. Maintenance Data: For fire alarm system to include in the operation and maintenance manuals specified in Form 818 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS. The equipment manufacturer shall make available to the Engineer a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA-72H guidelines.

F. Warranty: Special warranties specified in Part 1.9, “Warranty.”

1.7 QUALITY ASSURANCE:

A. Each and all items of the Fire Alarm System shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by the Underwriters' Laboratories, Inc. (UL) and shall bear the "UL" label. All control equipment shall be listed under UL category UOJZ as a single control unit. Partial listing shall NOT be acceptable.

B. In addition to the UL-UOJZ requirement listed above, the system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760-23.

C. The complete installation shall conform to the applicable sections of NFPA-72 A through H, Local Code Requirements and NEC Code Article 760.

D. The fire alarm system shall be UL listed and in accordance with all applicable documents.

E. Installation and commissioning technicians shall be factory trained within the last two years on the specific equipment listed for the project.

F. Installation and commissioning technicians shall be NICET Level II or above for fire alarm technology. Technicians' names and certificate number shall be provided for this particular project as part of the submittal process.

G. Manufacturers shall have a minimum of five years experience in the design, manufacture, and maintenance of fire alarm equipment.

H. Local service agency shall have a minimum of $10,000 of spare parts and be within 50-mile radius of the Project Site. Name and address of service agency along with location of spare parts inventory shall be furnished as part of submittal process.

1.8 SPARE PARTS:

A. Furnish to the Engineer spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Two addressable smoke detectors
2. Two audio/visual strobe units
3. Two addressable Pull stations
4. One Duct Smoke Detector

5. One addressable Heat detector

1.9 WARRANTIES:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period.

C. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, all the equipment shall be the product of Notifier, or an approved equal.

2.2 FIRE ALARM CONTROL PANEL:

A. Operator interface switches for alarm acknowledge/ silence, system reset, trouble silence with ringback, municipal connection circuit disconnect.

B. Visible LED indicators, through a locked door with protective glass window for: AC Power (green), Power Trouble (yellow), System Trouble (yellow), Ground Trouble (yellow), and an eighty-character LCD display.

C. Field programmable microprocessor. No special programming tools shall be required. Systems that cannot be fully programmed by the keypad installed on the system shall supply to the ConnDOT a system programmer or any other device needed to make program changes and maintain the system.

D. UL approved alarm verification operation.

E. Offsite monitoring output capability of remote station reverse polarity, local energy master box, or shunt master box types be field selectable within the control panel.

F. Surge protection of the system power supply and the municipal connection circuit.

G. The system shall be capable of monitoring a minimum of 198 addressable points.

H. Control module with two (2) form-C alarm relays with dry contacts rated 2 amps 120 VAC, to provide interfacing to HVAC equipment.

I. Fire alarm dialer shall be provided and integrated with the control panel for off-site central station-style monitoring through the dial-up public switched telephone network.

J. The panel shall be surface mounted. Panel shall be constructed of steel with baked enamel scratch resistant red paint and shall have a key-operated locked door with shatter resistant glass viewing window.

2.3 REMOTE ANNUNCIATOR:

A. The remote annunciator shall have an eighty-character LCD display and indicate all alarms and troubles the same as the main control panel. The remote annunciator shall have a locking smoked plexiglass door that may be opened to access the buttons for acknowledge, signal silence and system reset. The remote annunciator shall be electrically supervised from the control panel.

2.4 PERIPHERAL DEVICES - FIRE ALARM SYSTEM:

A. Manual Pull Stations:

1. Addressable manual stations shall be single action and shall be constructed of high impact, red Lexan with raised white lettering and a smooth high gloss finish. The station shall have a hinged front with key lock. Stations which utilize screwdrivers, Allen wrenches, or other commonly available tools shall not be accepted. Stations shall be keyed alike with the Fire Alarm Control Panel. When the station is operated, the handle shall lock in a protruding manner to facilitate quick visual identification of the activated station.

2. Manual stations shall be designed so that after emergency operation they cannot be restored to normal except by use of a key. Manual stations shall be UL listed.

B. Smoke Detectors:

1. Addressable smoke detectors shall be photoelectric type UL 268 listed. The detectors shall have a functional test feature that simulates smoke.
2. Each detector shall have a flashing status indicating LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady and at full brilliance. The detector may be reset by actuating the control panel reset switch.
3. To minimize nuisance alarms, voltage and RF transient suppression techniques shall be employed as well as a smoke verification circuit and an insect screen. The detector design shall provide full solid-state construction and compatibility with other normally open fire alarm detection loop devices (heat detectors, pull stations, etc.). The detector head shall be easily disassembled to facilitate cleaning.

C. Audio Visual Alarm Unit:

1. Audio Visual units shall be made of red impact resistant and flame retardant thermoplastic injection molded frame with a xenon strobe lamp. The assemblies shall be flush mounted to a 4 inch square electrical box. The white Lexan lens shall have the word 'FIRE' in red lettering on the front. Alarm horns shall be polarized and shall be operated by 24 VDC. Each horn assembly shall include separate terminals for in/out wiring for each leg of the associated signal circuit. T-tapping of signal device conductors to signal circuit conductors shall NOT be accepted. The alarm horns shall be suitable for front mounting on audio-visual assemblies.

D. Visual Flashing Lamps (Xenon Strobe):

1. Visual indicating appliances shall be comprised on a Xenon flashtube and be entirely solid state. These devices shall be UL listed and be capable of wall mounting. The Lexan lens shall be rectangular in shape to allow better visibility.
2. The ADA guidelines specify strobe intensity of 75 candela at 50 feet from the appliance. Although strobe intensity requirements of ADA & NFPA 72 differ, these can be resolved by comparing the strobe coverage of UL-1971 and applying 'equivalent facilitation'.

E. Duct Smoke Detectors:

1. Addressable air duct smoke detectors shall consist of a standard photoelectric detector, two air sampling tubes, and a sampling chamber, capable of detecting the products of combustion. The two tubes shall provide a means for obtaining a sample of air in the duct. A pressure differential shall cause air to be pulled through the first sampling chamber which contains the photoelectric detector. Air shall return from the chamber to the duct through the second tube. Sensitivity shall be field adjustable in accordance with UL 268. The air duct smoke detectors shall each include form "C" contacts and a remote LED alarm light complete with necessary box, etc. for remote surface mounting. The remote LED shall be wired for manual reset. Duct smoke detectors shall be provided with test stations. Locations of test stations are shown on the plans.

F. Heat detectors: Comply with UL 521

1. Heat Detector, fixed temperature type: Actuated by temperature that exceeds a fixed temperature of 135 deg F Provide adapter plate for outlet box mounting. The integral addressable module shall be arranged to communicate the detector's status (normal, alarm, trouble).

2. Heat Detector, fixed temperature type: Actuated by temperature that exceeds a fixed temperature of 190 deg F. Provide adapter plate for outlet box mounting. The integral addressable module shall be arranged to communicate the detector's status (normal, alarm, trouble).
3. Non-addressable heat detector for the Storage Building. Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F. Heat detectors shall be weatherproof for un-conditioned spaces in the Storage Building.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Provide and install complete and operable system in accordance with the plans, specifications, all applicable codes, and manufacturer's recommendations. All wiring for the fire alarm system shall be in a completely separate conduit system. All junction boxes, outlet, device, couplings, and any other fire alarm box shall be sprayed red and labeled "FIRE ALARM". Wiring color codes shall be maintained throughout the installation.

B. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate Installers. All applicable Installers shall be present at the same time for connections to other building systems.

C. The manufacturer's authorized representative shall provide onsite supervision of installation.

D. Clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of installation and must meet all qualifications regarding certification and training as listed.

3.2 TESTING:

A. The completed fire alarm system shall be fully tested in accordance with NFPA-72H by the Installer in the presence of the Engineer's representative. Upon completion of a successful test, the Installer shall provide a certified test report to the Engineer.

3.3 TRAINING:

A. Refer to Form 818 Article 1.20-1.08-14 subsection 3 for additional information.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and the maintain fire detection and alarm system.

END OF SECTION 283111

SECTION 300000 – FORM 818 SITE WORK

PART 1 - GENERAL:

1.1 SUMMARY:

A. DEMOLITION: Refer to Form 818 Article 1.20-1.08.03 subsection 05 for requirements related to this work.

B. SIGNS: Refer to Form 818 Article 12.07.01 for requirements related to this work.

C. CLEARING AND GRUBBING: Refer to Form 818 Article 02.01.01 for requirements related to this work.

D. ROCK EXCAVATION: Refer to Form 818 Article 02.02.01 for requirements related to this work.

E. CUT BITUMINOUS CONCRETE PAVEMENT: Refer to Form 818 Article 02.02.01 for requirements related to this work.

F. STRUCTURE EXCAVATION – EARTH (COMPLETE): Refer to Form 818 Article 02.03.01 for requirements related to this work.

G. STRUCTURE EXCAVATION – ROCK (COMPLETE): Refer to Form 818 Article 02.03.01 for requirements related to this work.

H. TRENCH EXCAVATION (0’-10’ DEEP): Refer to Form 818 Article 02.86.01 for requirements related to this work.

I. ROCK IN TRENCH EXCAVATION (0’-10’ DEEP): Refer to Form 818 Article 02.86.01 for requirements related to this work.

J. TRENCH EXCAVATION (0’-20’ DEEP): Refer to Form 818 Article 02.86.01 for requirements related to this work.

K. ROCK IN TRENCH EXCAVATION (0’-20’ DEEP): Refer to Form 818 Article 02.86.01 for requirements related to this work.

L. BORROW: Refer to Form 818 Article 02.07.01 for requirements related to this work.

M. ANTI-TRACKING PAD: Refer to Form 818 Article 02.11.01 for requirements related to this work.

N. WATER POLUTION CONTROL: Refer to Form 818 Article 01.10.03 for requirements related to this work.

O. GRANULAR FILL: Refer to Form 818 Article 02.13.01 for requirements related to this work.

P. COMPACTED GRANULAR FILL: Refer to Form 818 Article 02.14.01 for requirements related to this work.

Q. SEDIMENTATION CONTROL SYSTEM: Refer to Form 818 Article 02.19.01 for requirements related to this work.

R. TYPE 'C' CATCH BASIN: Refer to Form 818 Article 05.86.01 for requirements related to this work.

S. TYPE 'C' CATCH BASIN TOP: Refer to Form 818 Article 05.86.01 for requirements related to this work.

T. TYPE 'C-L' CATCH BASIN: Refer to Form 818 Article 05.86.01 for requirements related to this work.

U. MANHOLE: Refer to Form 818 Article 05.86.01 for requirements related to this work.

V. MANHOLE OVER 10' DEEP: Refer to Form 818 Article 05.86.01 for requirements related to this work.

W. BEDDING MATERIAL: Refer to Form 818 Article 06.86.02 for requirements related to this work.

X. 12" R.C. PIPE CLASS V: Refer to Form 818 Article 06.86.01 for requirements related to this work.

Y. 15" R.C. PIPE CLASS V: Refer to Form 818 Article 06.86.01 for requirements related to this work.

Z. 18" R.C. PIPE CLASS V: Refer to Form 818 Article 06.86.01 for requirements related to this work.

AA. 6" POLYCINYL CHLORIDE PIPE: Refer to Form 818 Article 05.13.01 for requirements related to this work.

BB. 18" R.C. CULVERT END: Refer to Form 818 Article 06.86.01 for requirements related to this work.

CC. MODIFIED RIPRAP: Refer to Form 818 Article 07.03.01 for requirements related to this work.

DD. GEOTEXTILE (SEPARATION – MEDIUM SURVIVABILITY): Refer to Form 818 Article 07.55.01 for requirements related to this work.

EE. BITUMINOUS CONCRETE LIP CURBING: Refer to Form 818 Article 08.15.01 for requirements related to this work.

FF. TEMPORARY PRECAST CONCRETE BARRIER CURB: Refer to Form 818 Article 08.22.01 for requirements related to this work.

GG. METAL BEAM RAIL (TYPE R-B 350): Refer to Form 818 Article 09.10.01 for requirements related to this work.

HH. WATER FOR DUST CONTROL: Refer to Form 818 Article 09.43.01 for requirements related to this work.

II. FURNISHING AND PLACING TOPSOIL: Refer to Form 818 Article 09.44.01 for requirements related to this work.

JJ. PAINTED PAVEMENT MARKINGS (GENERAL): Refer to Form 818 Article 12.09.01 for requirements related to this work.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. DEMOLITION: Refer to Form 818 Article 1.20-1.08.03 subsection 05 for requirements related to this work.

B. SIGNS: Refer to Form 818 Article 12.07.02 for requirements related to this work.

C. CLEARING AND GRUBBING: N/A

D. ROCK EXCAVATION: N/A

E. CUT BITUMINOUS CONCRETE PAVEMENT: N/A

F. STRUCTURE EXCAVATION – EARTH (COMPLETE): N/A

G. STRUCTURE EXCAVATION – ROCK (COMPLETE): N/A

H. TRENCH EXCAVATION (0’-10’ DEEP): N/A

I. ROCK IN TRENCH EXCAVATION (0’-10’ DEEP): N/A

J. TRENCH EXCAVATION (0’-20’ DEEP): N/A

K. ROCK IN TRENCH EXCAVATION (0’-20’ DEEP): N/A

L. BORROW: Refer to Form 818 Article 02.07.02 for requirements related to this work.

M. ANTI-TRACKING PAD: Refer to Form 818 Article 02.11.02 for requirements related to this work.

N. WATER POLUTION CONTROL: Refer to Form 818 Article 01.10.03 for requirements related to this work.

O. GRANULAR FILL: Refer to Form 818 Article 02.13.02 for requirements related to this work.

P. COMPACTED GRANULAR FILL: Refer to Form 818 Article 02.14.02 for requirements related to this work.

Q. SEDIMENTATION CONTROL SYSTEM: Refer to Form 818 Article 02.19.02 for requirements related to this work.

R. TYPE 'C' CATCH BASIN: Refer to Form 818 Article 05.86.02 for requirements related to this work.

S. TYPE 'C' CATCH BASIN TOP: Refer to Form 818 Article 05.86.02 for requirements related to this work.

T. TYPE 'C-L' CATCH BASIN: Refer to Form 818 Article 05.86.02 for requirements related to this work.

U. MANHOLE: Refer to Form 818 Article 05.86.02 for requirements related to this work.

V. MANHOLE OVER 10' DEEP: Refer to Form 818 Article 05.86.02 for requirements related to this work.

W. BEDDING MATERIAL: Refer to Form 818 Article 06.86.02 for requirements related to this work.

X. 12" R.C. PIPE CLASS V: Refer to Form 818 Article 06.86.02 for requirements related to this work.

Y. 15" R.C. PIPE CLASS V: Refer to Form 818 Article 06.86.02 for requirements related to this work.

Z. 18" R.C. PIPE CLASS V: Refer to Form 818 Article 06.86.02 for requirements related to this work.

AA. 6" POLYCINYL CHLORIDE PIPE: Refer to Form 818 Article 05.13.02 for requirements related to this work.

BB. 18" R.C. CULVERT END: Refer to Form 818 Article 06.86.02 for requirements related to this work.

CC. MODIFIED RIPRAP: Refer to Form 818 Article 07.03.02 for requirements related to this work.

DD. GEOTEXTILE (SEPARATION – MEDIUM SURVIVABILITY): Refer to Form 818 Article 07.55.02 for requirements related to this work.

EE. BITUMINOUS CONCRETE LIP CURBING: Refer to Form 818 Article 08.15.02 for requirements related to this work.

FF. TEMPORARY PRECAST CONCRETE BARRIER CURB: Refer to Form 818 Article 08.22.02 for requirements related to this work.

GG. METAL BEAM RAIL (TYPE R-B 350): Refer to Form 818 Article 09.10.02 for requirements related to this work.

HH. WATER FOR DUST CONTROL: N/A

II. FURNISHING AND PLACING TOPSOIL: Refer to Form 818 Article 09.44.02 for requirements related to this work.

JJ. PAINTED PAVEMENT MARKINGS (GENERAL): Refer to Form 818 Article 12.09.02 for requirements related to this work.

PART 3 - EXECUTION

3.1 EXECUTION:

A. DEMOLITION: Refer to Form 818 Article 1.20-1.08.03 subsection 05 for requirements related to this work.

B. SIGNS: Refer to Form 818 Article 12.07.03 for requirements related to this work.

C. CLEARING AND GRUBBING: Refer to Form 818 Article 02.01.03 for requirements related to this work.

D. ROCK EXCAVATION: Refer to Form 818 Article 02.02.03 for requirements related to this work.

E. CUT BITUMINOUS CONCRETE PAVEMENT: Refer to Form 818 Article 02.02.03 for requirements related to this work.

F. STRUCTURE EXCAVATION – EARTH (COMPLETE): Refer to Form 818 Article 02.03.03 for requirements related to this work.

G. STRUCTURE EXCAVATION – ROCK (COMPLETE): Refer to Form 818 Article 02.03.03 for requirements related to this work.

H. TRENCH EXCAVATION (0’-10’ DEEP): Refer to Form 818 Article 02.86.03 for requirements related to this work.

I. ROCK IN TRENCH EXCAVATION (0'-10' DEEP): Refer to Form 818 Article 02.86.03 for requirements related to this work.

J. TRENCH EXCAVATION (0'-20' DEEP): Refer to Form 818 Article 02.86.03 for requirements related to this work.

K. ROCK IN TRENCH EXCAVATION (0'-20' DEEP): Refer to Form 818 Article 02.86.03 for requirements related to this work.

L. BORROW: Refer to Form 818 Article 02.07.03 for requirements related to this work.

M. ANTI-TRACKING PAD: Refer to Form 818 Article 02.11.03 for requirements related to this work.

N. WATER POLUTION CONTROL: Refer to Form 818 Article 01.10.03 for requirements related to this work.

O. GRANULAR FILL: Refer to Form 818 Article 02.13.03 for requirements related to this work.

P. COMPACTED GRANULAR FILL: Refer to Form 818 Article 02.14.03 for requirements related to this work.

Q. SEDIMENTATION CONTROL SYSTEM: Refer to Form 818 Article 02.19.03 for requirements related to this work.

R. TYPE 'C' CATCH BASIN: Refer to Form 818 Article 05.86.03 for requirements related to this work.

S. TYPE 'C' CATCH BASIN TOP: Refer to Form 818 Article 05.86.03 for requirements related to this work.

T. TYPE 'C-L' CATCH BASIN: Refer to Form 818 Article 05.86.03 for requirements related to this work.

U. MANHOLE: Refer to Form 818 Article 05.86.03 for requirements related to this work.

V. MANHOLE OVER 10' DEEP: Refer to Form 818 Article 05.86.03 for requirements related to this work.

W. BEDDING MATERIAL: Refer to Form 818 Article 06.86.03 for requirements related to this work.

X. 12" R.C. PIPE CLASS V: Refer to Form 818 Article 06.86.03 for requirements related to this work.

Y. 15" R.C. PIPE CLASS V: Refer to Form 818 Article 06.86.03 for requirements related to this work.

Z. 18” R.C. PIPE CLASS V: Refer to Form 818 Article 06.86.03 for requirements related to this work.

AA. 6” POLYCINYL CHLORIDE PIPE: Refer to Form 818 Article 05.13.03 for requirements related to this work.

BB. 18” R.C. CULVERT END: Refer to Form 818 Article 06.86.03 for requirements related to this work.

CC. MODIFIED RIPRAP: Refer to Form 818 Article 07.03.03 for requirements related to this work.

DD. GEOTEXTILE (SEPARATION – MEDIUM SURVIVABILITY): Refer to Form 818 Article 07.55.03 for requirements related to this work.

EE. BITUMINOUS CONCRETE LIP CURBING: Refer to Form 818 Article 08.15.03 for requirements related to this work.

FF. TEMPORARY PRECAST CONCRETE BARRIER CURB: Refer to Form 818 Article 08.22.03 for requirements related to this work.

GG. METAL BEAM RAIL (TYPE R-B 350): Refer to Form 818 Article 09.10.03 for requirements related to this work.

HH. WATER FOR DUST CONTROL: Refer to Form 818 Article 09.43.03 for requirements related to this work.

II. FURNISHING AND PLACING TOPSOIL: Refer to Form 818 Article 09.44.03 for requirements related to this work.

JJ. PAINTED PAVEMENT MARKINGS (GENERAL): Refer to Form 818 Article 12.09.03 for requirements related to this work.

END OF SECTION 300000

SECTION 300500 – TEMPORARY MAINTENACE WORK AREA

PART 1 - GENERAL

1.1 SUMMARY:

A. The Contractor shall provide temporary facilities for the exclusive use of Department personnel.

B. The Contractor shall:

1. Purchase (2) storage containers to supplement (2) existing storage containers.
2. Set-up all temporary facilities on the Project Site.
3. Connect all temporary facilities to all utilities and support services.
4. Make all temporary facilities fully functional and acceptable to the Engineer prior to the start of demolition of the existing building or the existing motor fuel island.
5. Install

C. The Department will make the following materials available to the Contractor. Current onsite tank and limited accessories to be relocated to establish the temporary facilities:

1. 8,000 gal. Aboveground Storage Tank and attached tank top equipment.
2. Access Stairs and Guide Railings System.
3. Fuel Dispenser.
4. Fuel Management Unit.
5. Nozzle and Hose.
6. Filter and Adapter.

Contact Engineer a minimum of 72 hours in advance to make arrangements to move tank/ materials.

D. Temporary facilities shall remain on the Project Site for the duration of the Project, including Contract time extensions if any occur, and if required for a maximum of 30 days thereafter.

E. Temporary facilities shall be removed from the Project Site as described herein, unless otherwise noted.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS for the fuel dispensing equipment.

B. Product Data: For each type of product indicated. Include rated capacities of selected model clearly indicated, installation and start-up instructions, and calibration charts.

C. Shop Drawings: If required by the Engineer, include wiring diagrams that detail wiring for power, signal, and control systems and differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. The Engineer will approve the remaining materials to be installed by the Contractor, unless otherwise noted.

PART 2 - PRODUCTS

2.1 STORAGE CONTAINERS:

A. The storage containers shall have a minimum of 320 square feet of floor space and a ceiling height of 7 feet. Storage containers shall be weatherproof and of all steel construction with integral steel skids for ground level placement and accessibility. Tractor-trailer storage is not acceptable.

B. Storage containers shall include heavy-duty double steel doors with locking bars located at one end of unit. Doors shall include provisions for Owner supplied padlocks.

C. A minimum of 2 overhead electric lights shall be provided in one storage container. Lighting shall be a 4 foot linear type fixture, rated for wet location, suitable for interior and exterior installation. Cree Model No. WS4 47L 40K 10V FD SSL, or an approved equal. The fixture, workbox, conduit, and associated electrical equipment shall be fastened with corrosion resistant hardware as specified under CSI Division 26 Section 260529, "Hangers and Supports for Electrical Systems."

D. One storage container shall be equipped with electrical distribution to the following specifications: 120/208 volt, single phase, 3 wire sub-feed from the power source shown on the plans. The Contractor shall conform to all applicable requirements of the NEC.

2.2 FUEL DISPENSING ISLAND:

A. Precast Concrete Barriers: Refer to Form 818, Section 8.21 “Precast Concrete Barrier Curb” for material and construction methods required.

B. Steel Plate: 1” thick steel plate, conforming to ASTM A36, with minimum dimensions as shown on the plans.

C. The fuel dispensing equipment (tank, tank accessories, fuel dispenser, FMU, emergency controls and miscellaneous components) shall meet all of the applicable regulatory requirements set forth by ASTM, NFPA, STI, and UL.

D. The Contractor shall provide mounting hardware and miscellaneous parts to complete installation.

E. Floodlight and Support: The floodlights shall be rugged, weather resistant die-cast aluminum with gasket, and shall be equipped with a photocell for Dusk-to-Dawn operation. Lithonia Model No. OFTH300PR with two 90 Watt lamps, 120 Volts, and photocell, or an approved equal. The mast support for the lights shall be composed of steel c-channel as specified under CSI Division 26 Section 260529, "Hangers and Supports for Electrical Systems."

F. The Contractor shall use threaded RGSC for all power and communication feeds when conduits enter into a Class I, Division 1/Division 2 hazardous location and for all surface mounted conduit around the dispenser as shown on Drawing No. ET-001.

G. The Contractor shall use a minimum #12 stranded copper conductors rated for 600 volts with THWN or THNN insulation within the Class I, Division 1 hazardous location unless otherwise noted. Grounding wire shall be green-type.

H. Junction Boxes shall be threaded, explosion-proof, Model No. GRSS-2 as manufactured by Killark, or an approved equal.

I. Explosion-proof fittings shall be threaded, recessed-type, close-up plugs, Model No. EYSF75 as manufactured by Appleton, or an approved equal. Screwdriver slotted close-up plugs shall not be accepted. When necessary to employ flexible connections, as at motor terminals, flexible fittings listed for Class I locations shall be used.

J. Conduit Seals shall be approved for Class I, Division I locations as described in section 501-15(a)-(f) of the NEC. Sealing compound shall be approved and shall provide a seal against passage of gas or vapors through the seal fitting, shall not be affected by the surrounding atmosphere or liquids, shall not have melting point of less than 200 degrees F. In a completed seal, the minimum thickness of the sealing compound shall no be less than the trade size of the sealing fitting and, in no case, less than 5/8 inch.

K. Each circuit leading to or through dispensing equipment, including equipment for remote pumping systems, shall be provided with a clearly identified and readily accessible switch or other acceptable means, located remote from the dispensing device, to disconnect simultaneously from the source of supply, all conductors of the circuit, including the grounded (neutral) conductor. Emergency controls shall be more than 20 feet but less than 100 feet from the dispenser.

L. Emergency Shut-off (Quick Stop Button): The quick stop button functions to remove power by depressing the red mushroom-shaped button. Power restored by manually resetting the shunt trip device and turning the button clockwise a partial turn until it pops back out to the reset position.

M. The dispenser shall be controlled by the dispenser's "on/off" handle at the point of fuel distribution and remotely by the circuit breaker.

N. Fixed wiring: Threaded RGSC with termination fittings and wiring methods approved for Class I location shall be employed. All boxes, fittings and joints shall be threaded for connection to conduit and shall be explosion-proof. Threaded joints shall be made up with at least 5 threads fully engaged.

O. Grounding: All metal raceways and all non-current carrying metal parts of fixed or portable electrical equipment, regardless of voltage, shall be grounded as provided in NEC Article 250 and per Article 514-16. The locknut–bushing and double-locknut types of contacts shall not be depended on for bonding purposes, but bonding jumpers with proper fittings shall be used. Such means of bonding shall apply to all intervening raceways, fittings, boxes, enclosures, etc., between Class I location and the point of grounding for service equipment. Bonding shall be jumpers with proper fittings for bonding purposes.

P. An approved seal shall be provided in each conduit run entering or leaving a dispenser or any cavities or enclosures in direct communication therewith. The sealing fitting shall be the first fitting after the conduit emerges from the earth or the concrete.

Q. Splices and taps shall not be made in fittings intended only for sealing with compound, nor shall other fittings in which splices or taps are made be filled with compound.

R. The cross-sectional area of the conductors permitted in a seal shall not exceed 25% of the cross-sectional area of a RGSC of the same trade.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

A. The Contractor shall locate temporary facilities where shown on the plans and as directed by the Engineer. The temporary facilities shall be installed in accordance with Form 818 Article 1.08.02, as supplemented herein.

B. The Contractor shall provide applicable utility extensions to all trailers and storage containers.

C. Block Heater Area Floodlight and Support: The Contractor shall firmly attach the c-channel mast to the wooden block heater post. The Contractor shall install a surface mounted metallic box to attach the floodlights to the mast. The Contractor shall install a single gang box rated for exterior use and single pole switch with exterior switch cover, wired to control the floodlights. Route surface mounted RGSC conduit along the c-channel to feed the floodlights.

3.2 INSTALLATION, FUEL DISPENSING ISLAND:

A. The Contractor shall install each component of the fuel dispensing island as shown on the plans, in accordance with manufacturer's installation instructions, and in accordance with NFPA 30 and 30A. Additional installation requirements are described herein, where applicable. The Contractor shall provide a fully operational system when complete.

B. The Contractor shall modify the AST and dispenser as necessary to be used to store and dispense diesel fuel. The Contractor shall verify fuel dispenser is secured to tank and all necessary piping connections are completed.

C. The Contractor shall verify the existing fill assembly complies with the requirements of NFPA 30A and incorporates the following features:

1. A lockable tight fill cap, adapter, fill pipe, and drop tube.
2. The bottom of the fill drop tube shall be cut at a 45-degree angle with the open end facing the long dimension of the tank.
3. The drop tube shall terminate 6-inches from the bottom of the tank.

D. The Contractor shall verify the existing overfill prevention equipment complies with the requirements of NFPA 30A and incorporates the following features:

1. An audible alarm which will sound when the product level in the tank has reached 85% of tank capacity, or a liquid level gauge marked at 85% of tank capacity.
2. A positive shut-off fill limiter which will stop the flow of liquid into the tank when product level reaches 90% of tank capacity.
3. The fill-limiting device shall be rated to accept the fill flow rate and pressure.

E. The Contractor shall verify the existing product piping at the tank includes and anti-siphon device that will prevent the flow of liquid from the tank unless the suction pump is operating, in accordance with NFPA 30A.

F. The Contractor shall verify that a pressure relief valve is included in each segment of blocked piping that will relieve excessive pressure resulting from thermal expansion and return any excess product to the tank.

G. The tank and associated equipment shall be installed in accordance with the STI installation instructions for Fireguard aboveground tanks (Publication No. R942-94, Installation and Testing Instructions for Thermally Insulated Lightweight Double Wall Fireguard Aboveground Storage Tanks).

H. The Contractor shall (1) use tank handling equipment of adequate size to lift and set the tank without dragging or dropping it; (2) advise the Engineer of any shipping or handling damage encountered; and (3) not make any modifications to any tank without the prior written approval of the manufacturer and the Engineer. Such modifications include any welding on tank shells, adding penetrations in the tank structure, or repairing damage that might affect the integrity of the inner or outer tank.

I. The Contractor shall locate the temporary steel plate where shown on the plans and as directed by the Engineer.

J. The Contractor shall locate precast concrete barriers where shown on the plans and as directed by the Engineer.

K. The Contractor shall protect existing exposed piping and equipment from corrosion by painting or wrapping it with a coating that is compatible with diesel fuel and the conditions of the exposure.

L. The Contractor shall locate the concrete pad for the temporary FMU where shown on the plans and as directed by the Engineer.

M. Install temporary FMU and retrofit to work with dispenser.

N. Provide a fully operational temporary automated fuel management system. The temporary FMU shall interface with the existing head-end located at 2800 Berlin Turnpike, Newington, CT. Coordinate dial-up programming with the Department Fuel Control. The following information shall be recorded by the system for each fueling transaction: user identification number, vehicle odometer/hourmeter, vehicle number, quantity of fuel dispensed, fuel site, date and time, hose number and product number, and key type.

O. FMU Power Requirements: 120 volts, 60 Hz, from a separate dedicated circuit.

P. Floodlight and Support: The Contractor shall firmly attach the c-channel mast to the precast concrete barrier. The Contractor shall install a surface mounted metallic box to attach the floodlights to the mast. Route surface mounted RGSC conduit along the c-channel to feed the floodlights.

Q. The Contractor shall install all conduit, boxes, and wiring in accordance to NFPA 70 and shall run green bond wire in all conduits.

R. The Contractor shall install RGSC from the source of power to the fuel dispensing system, and complete conduit, terminations with explosion-proof fittings. All E.Y. fittings for conduit runs to the fuel island shall be properly sealed. The Contractor shall leave close-up plugs hand tight after sealing to provide for the Engineer's inspection of these fittings.

S. The Contractor shall extend fuel dispensing island power and communication circuits from the power panels and communication cabinets in the temporary service area to the temporary fuel island location. The Contractor shall complete all necessary terminations in accordance with NEC Article 514 and sections described above.

T. The Contractor shall perform air pressure testing of the inner tank and secondary containment tank on-site in the presence of the Engineer before placing the tank in service. Refer to STI Publication No. R942-94 for complete procedural details.

U. The Contractor shall test piping on-site in the presence of the Engineer before placing the piping in service. The Contractor shall perform minimum hydrostatic or pneumatic test-pressures measured at highest point in system, minimum 1.5 times the designed working pressure but not less than 5 psig for minimum 2 hours, isolate storage tanks if test pressure in piping will cause pressure in storage tanks to exceed 10 psig and shall soap pipe fittings. Piping will be considered defective if it does not pass tests. Defective piping shall be repaired or replaced, and then retested.

V. The Contractor shall test each component of the system for calibration, tightness and proper operation in accordance with the instructions of the component manufacturer.

W. Testing shall be documented by the Contractor and witnessed by the Engineer. Record the date and time of the test, the name of the tester and their affiliation with the Project, and the names of each individual witnessing the test. The Contractor shall record the test method, duration and results, and provide a record of the testing to the Engineer at the time of system start-up.

X. The Owner will supply diesel fuel to fill the temporary AST upon its acceptance by the Engineer.

3.3 MAINTENANCE AND REPAIRS:

A. The Contractor shall be responsible for maintenance and repairs to Storage Containers provided or installed under the above requirements at all times during occupancy by the Department. The Department will be responsible for maintenance and repairs to the fuel dispensing island.

B. Ownership and liability of the fuel dispensing island will remain with the Engineer.

3.4 PROJECT CLOSEOUT:

A. When the Engineer determines that the temporary facilities are no longer needed, the Department will vacate the facilities and empty the temporary AST.

1. Storage Containers will remain on the Project Site as Owner property.

B. The Contractor shall prepare the following Owner equipment for salvage and removal from the Project Site, including but not limited to the removal of connected utilities:

1. Equipment identified in Part 1.1C (note 8,000 gal AST and attached tank top equipment shall be relocated for the permenant fuel island).
2. Block Heater Area Floodlights and Supports.
3. Personnel and Restroom Trailer Wallpack Lighting.
4. Fuel Island components and plywood backboards.

C. The Contractor shall:

1. Demolish all work not identified to be salvaged.
2. Relocate the precast concrete barriers on the Project Site as directed by the Engineer
3. Complete Project Site work.

END OF SECTION 300500

SECTION 302000 – GENERAL SITE WORK

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Asphalt Storage Shed
2. Bollard
3. Concrete Apron
4. Concrete Pad
5. Concrete Washout Area
6. Concrete Wheel Stop
7. Controlled Low Strength Material (Flowable Fill)
8. CORS Station
9. Flagpole
10. Fuel Island Canopy
11. Furnishing, Planting and Mulching Trees, Shrubs, Vines and Ground Cover Plants
12. No.3 Crushed Stone
13. Peastone Gravel Backfill
14. Steel Bollard
15. Storage Container

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Asphalt Storage Shed
2. Bollard
3. Flagpole
4. Fuel Island Canopy
5. Furnishing, Planting and Mulching Trees, Shrubs, Vines and Ground Cover Plants
6. Steel Bollard

C. Shop Drawings:

1. Asphalt Storage Shed
2. Concrete pad.
3. CORS Station
4. Fuel Island Canopy

PART 2 - PRODUCTS

2.1 MATERIALS:

A. ASPHALT STORAGE SHED

B. BOLLARD:

1. Steel bollard: Schedule 80 galvanized steel pipe, 8 inch nominal size (8.625" O.D.), conforming to the requirements of ASTM-A53.
2. Concrete: Comply with requirements of CSI Division 03, Section 033000, "Cast-in-Place Concrete".
3. Polyethylene sleeve. Bumper (Bollard) Post Sleeve #PLS1009, as manufactured by New Pig Corporation or approved equivalent. Sleeve shall be yellow in color with ¼"-thick polyethylene shell.

C. CONCRETE APRON:

1. Concrete: Comply with requirements of CSI Division 03, Section 033000, "Cast-in-Place Concrete".
2. Steel Reinforcement: Comply with requirements of CSI Division 03, Section 033000, "Cast-in-Place Concrete" Section 2.2.
3. Water Repellants: Comply with requirements of CSI Division 07, Section 071900, "Water Repellants".

D. CONCRETE PAD:

1. Concrete: Comply with requirements of CSI Division 03, Section 033000, "Cast-in-Place Concrete".
2. Steel Reinforcement: Comply with requirements of CSI Division 03, Section 033000, "Cast-in-Place Concrete" Section 2.2.
3. Water Repellants: Comply with requirements of CSI Division 07, Section 071900, "Water Repellants".

E. CONCRETE WASHOUT AREA: Refer to Contract Plan Sheets for requirements related to this work.

F. CONCRETE WHEEL STOP:

1. Concrete: Comply with requirements of CSI Division 03, Section 033000, "Cast-in-Place Concrete", amended as follows:

a. Concrete shall have a minimum 28 day compressive strength of 4000 psi.
b. Reinforcement bars shall meet the requirements of Form 818, Article M.06.01.

G. CONTROLLED LOW STRENGHT MATERIAL (FLOWABLE FILL):

1. Materials: All materials utilized in the CLSM mix design shall be in accordance with the applicable requirements of Article M.03.01

a. Composition: The composition of the CLSM shall be in accordance with the requirements set forth in Article M.03.01-General Composition of Concrete Mixes, as well as the applicable sections of ACI 229R. The Contractor shall submit each proposed mix design, with all supporting data, to the Engineer for review and approval at least two weeks prior to its use.

b. The setting time of CLSM materials shall be designed so as to achieve the strength necessary to comply with the time constraints called for under the Maintenance and Protection of Traffic requirements of the project specifications. The use of chloride accelerators is not permitted.

c. The minimum compressive strength of the CLSM material shall be 30 pounds per square inch (psi) and the maximum compressive strength of the CLSM shall be 150 pounds per square inch (psi) when tested in accordance with ASTM D4832 after 56 days.

d. The CLSM mix design shall utilize a nominal maximum size of No. 8 aggregate as specified in M.01.01.

e. CLSM mixes shall have a minimum of 20% entrained air when tested in accordance with AASHTO T152.

H. CORS STATION:

1. Concrete: Shall meet the requirements of CSI Division 03, Section 033000, “Cast-in-Place Concrete”. Class F.
2. Steel Reinforcement: Comply with requirements of CSI Division 03, Section 033000, “Cast-in-Place Concrete” Section 2.2.
3. Water Repellants: Comply with requirements of CSI Division 07, Section 071900, “Water Repellants”.
4. Mast Steel: ASTM A36 Grade 50.
5. Steel for Anchor Bolts and Fasteners: ASTM F1554 Galvanized.
6. Grounding and Bonding: Comply with requirements of CSI Division 26 Section 260526, “Grounding and Bonding for Electrical Systems”
7. Raceways and Boxes: Comply with requirements of CSI Division 26 Section 260533, "Raceways and Boxes for Electrical Systems".
8. Conduit installed in trench: Comply with requirements of Division 26 Section 260543, "Underground Ducts and Raceways for Electrical Systems".
9. Power and Communication: Comply with requirements of Division 26 Section 262726, “Wiring Devices”

I. FLAGPOLE: Flagpoles shall be ESR40C71 as manufactured by American Flagpole or approved equal. Poles shall be tapered aluminum tubing and shall measure 40'-0" high from the finished grade. Provide standard revolving truck and cleat and 6" ball. Provide copper clad lightning rod. Flagpole foundation shall meet the requirements of CSI

Division 03, Section 033000 "Cast-in-Place Concrete". Flagpole foundation dimensions shall comply with manufacturer's specifications.

J. FUEL ISLAND CANOPY: Canopy shall be a 'Delegated Design' based on Austin Mohawks & Company DWG NO. 04-032, 36' X 86' X 6 Column Canopy with a minimum clearance of 16' or approved equal.

1. Provide 8 Cree CAN-304-SL-RS-06-E-UL-WH-700 304 Series Recessed LED Canopy Lights with Fixtures evenly spaced or approved equal.

K. FURNISHING, PLANTING AND MULCHING TREES, SHRUBS, VINES AND GROUND COVER PLANTS:

1. Comply with the requirements of Form 818 Article 09.49.02.

L. NO.3 CRUSHED STONE: Crushed stone shall be the product resulting from the artificial crushing of rocks, boulders or larger cobblestones, substantially all faces of which have resulted from the crushing operation. Crushed stone shall consist of sound, tough, durable stone, reasonably free from soft, thin, elongated, laminated, friable, micaceous or disintegrated pieces, mud, dirt or other deleterious material and shall be sized to meet the requirements of Form 818, Article M.01.01.

M. PEASTONE GRAVEL BACKFILL: Peastone gravel backfill shall be composed entirely of uncrushed stone sized rounded particles conforming to Section M.01.01 of the Form 818, Grading No. 6 unless otherwise specified by the tank manufacturer for compliance with the tank warranty.

N. STEEL BOLLARD:

1. Steel bollard: Schedule 40 galvanized steel pipe, 4 inch outside diameter, conforming to the requirements of ASTM-A53.
2. Concrete: Shall meet the requirements of CSI Division 03, Section 033000, "Cast-in-Place Concrete". Class F.
3. Paint: Bollard shall be primed and finished with "Highway Safety Yellow" rust preventive metal paint.

O. STORAGE CONTAINERS:

1. The storage containers shall have a minimum of 400 square feet of floor space and a ceiling height of 7 feet. Storage containers shall be weatherproof and of all steel construction with integral steel skids for ground level placement and accessibility. Tractor-trailer storage is not acceptable.
2. Storage containers shall include heavy-duty double steel doors with locking bars located at one end of unit. Doors shall include provisions for Owner supplied padlocks.

PART 3 - EXECUTION

3.1 EXECUTION:

A. ASPHALT STORAGE SHED

B. BOLLARD: Bollards shall be installed in the locations shown on the plans. The steel pipe shall be securely set plumb in concrete and filled with concrete. The polyethylene sleeve shall be installed as recommended by the manufacturer.

C. CONCRETE APRON: Comply with CSI Division 03, Section 033000, "Cast-in-Place Concrete. Aprons shall be constructed at the locations and to the dimensions shown on the plans.

D. CONCRETE PAD: Comply with CSI Division 03, Section 033000, "Cast-in-Place Concrete. Pads shall be constructed at the locations and to the dimensions shown on the plans.

E. CONCRETE WASHOUT AREA: Refer to Contract Plan Sheets for requirements related to this work.

F. CONCRETE WHEEL STOP: Concrete wheel stops shall be placed on the final layer of bituminous concrete pavement. The layout of concrete wheel stops shall be as shown on the plans and coordinated with the final pavement markings. Anchor dowels shall be driven flush with the top of the wheel stops.

G. CONTROLLED LOW STRENGTH MATERIAL (FLOWABLE FILL): CLSM shall only be placed when the ambient temperature is at least 32° F and rising. CLSM material shall be deposited within 2 hours of initial mixing. CLSM may be placed by chutes, conveyors, buckets or pumps depending upon the application and accessibility of the site. Should voids or cavities remain after the placement of the CLSM, the Contractor shall modify the placement method or flow characteristics of the CLSM. Voids or cavities which have not been filled properly shall be corrected as directed by the Engineer and at the Contractor's expense.

H. CORS STATION: Refer to Contract Plan Sheets for requirements related to this work. The welding shall be accordance with the current AWS code. Steel mast, gussets, and base plate shall be welded prior to hot dip galvanizing as a single piece in accordance with ASTM A153. The contract shall notify call before you dig prior to any excavation work. Work performed shall be coordinated with the Office of Central Surveys and performed under their supervision. Coordinate with the engineer.

I. FLAGPOLE: Install flagpole in location shown on the plans. All materials shall be installed in strict accordance with the manufacturer's recommendations.

J. FUEL ISLAND CANOPY: Refer to Contract Plan Sheets for requirements related to this work.

1. All work related to the demolition required for the construction of the canopy to be included under this pay item
2. All work related to the reinstallation of the fuel island equipment to be included under this pay item.

K. FURNISHING, PLANTING AND MULCHING TREES, SHRUBS, VINES AND GROUND COVER PLANTS:

1. All work under Form 818 Section 9.49 shall be performed in accordance with the latest edition of the ANSI A300 (Part 6).
2. Watering: All plants must be kept moist and be watered during the period from June 1 through October 31. The contractor shall submit verification of this work each month during the establishment period to ensure the minimum requirements have been met. The engineer may direct the contractor to provide additional water if drought conditions exist.
3. One-Year Establishment Period: Acceptance of all work under Section 9.49 for full payment shall be conditional on the successful completion of a 1-Year Establishment Period, as determined by the Engineer. The establishment period shall consist of a minimum of one full calendar year that will begin only after all plant materials specified in the Contract have been planted, and all initial planting operations have been accepted. The establishment period may extend past one calendar to coordinate the inventory and replacement. An inventory of all plant material will be conducted in the spring after plants have leafed out, or in the late summer after the warmest weather has past, and include the Contractor, the Engineer and the Landscape Designer. At this time the acceptability of the plant establishment as well as a list of corrective measures will be determined. The Contractor is responsible for procuring contract items for replacement and should take steps prior to receiving the inventory. The Contractor shall submit a plan for performing replacement work, which must include a thorough watering after planting. Replacement plants are subject to inspection before installation, and corrective measures must be approved before final acceptance.

L. NO.3 CRUSHED STONE: No. 3 crushed stone shall be deposited in layers not over 6" in depth, with each layer thoroughly compacted before the addition of other layers. Stone shall be placed in the locations and to the dimensions shown on the plans.

M. PEASTONE GRAVEL BACKFILL: Material shall be clean, dry and free from ice and snow, and shall be installed in accordance with the tank manufacturer's recommendations and as indicated on the Drawings, stated herein in the Specifications or as directed by the Engineer.

1. Underground Tanks: Provide a minimum of 12-inches of peastone gravel bed for tanks. At start of backfilling, care must be taken to work material completely beneath the bottom of the tanks and underneath the end caps to provide adequate support. Backfill completely over the top of tanks, up to the bottom of the concrete apron. Peastone gravel should be added and compacted in 12-inch lifts.

N. STEEL BOLLARD: Bollards shall be installed in the locations shown on the plans. The steel pipe shall be securely set plumb in concrete and shall comply with the manufacturer's recommendations.

O. STORAGE CONTAINERS: The Contractor shall locate the storage containers where shown on the plans and as directed by the Engineer.

END OF SECTION 302000

SECTION 304000 – FENCING AND GATES

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Fence:
   a. 6’ HIGH CHAIN LINK FENCE
   b. 6’ HIGH CHAIN LINK FENCE W/ PVC SLATS
2. Gates:
   a. 20’ CHAIN LINK DOUBLE GATE 6’ HIGH
   b. 24’ CHAIN LINK DOUBLE GATE 6’ HIGH
   c. 34’ CHAIN LINK DOUBLE GATE 6’ HIGH

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

1. Product Data in the form of manufacturer's technical data, specifications, and installation instructions for fence and gate posts, fabric, gates, and accessories.

2. Quality Assurance Submittals:

   a. Installer Qualifications: Engage an experienced Installer who has at least three years' experience and has completed at least five chain link fence projects with same material and of similar scope to that indicated for this Project with a successful construction record of in-service performance.

3. Single-Source Responsibility: Obtain chain link fence and gates, including accessories, fittings, and fastenings from a single source.

4. Submit samples for verification of PVC color in form of 6 inch length of actual fabric wire to be used in color selection.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. <u>FENCE AND GATES</u>

1. **Concrete:** Comply with requirements of CSI Division 03, Section 033000, "Cast-in-Place Concrete".

2. **General:** Round member sizes are given in actual outside diameter (OD) to the nearest thousandth of inches. Round fence posts and rails are often referred to in ASTM standard specifications by nominal pipe sizes (NPS) or the equivalent trade sizes in inches. The following indicates these equivalents all measured in inches:

Actual OD	NPS Size	Trade Size
1.315	1	1-3/8
1.660	1-1/4	1-5/8
1.900	1-1/2	2
2.375	2	2-1/2
2.875	2-1/2	3
3.500	3	3-1/2
4.000	3-1/2	4
6.625	6	6-5/8
8.625	8	8-5/8

3. **Fence Posts and Rail:**
   a. <u>General</u>: Type I Round Posts, standard weight (schedule 40) galvanized-steel pipe conforming to ASTM F 1083, according to heavy industrial requirements of ASTM F 669, Group IA, with minimum yield strength of 25,000 psi, not less than 1.8 oz. of zinc per sq. ft. Type A coating inside and outside according to ASTM F 1234, as determined by ASTM A 90, and weights per foot as follows:

Actual OD (in)	Weight (lb/ft)
1.315	1.68
1.660	2.27
1.900	2.72
2.375	3.65
2.875	5.79
3.500	7.58
4.000	9.11
6.625	18.97

8.625 28.55

b. Supplemental Color Coating: In addition to above metallic coatings, provide posts and rails with manufacturer's standard polymer coating according to ASTM F 1234, 10-mil minimum polyvinyl chloride (PVC) or 3-mil minimum polyester plastic resin finish applied to exterior surfaces and, except for tubular shapes, to exposed interior surfaces. Color to match chain link fabric.

c. Line or Intermediate Posts:
   1. Fence without PVC Slats
      a. Fence height of 8 feet or less: 2.375-inch OD Type I round steel pipe
      b. Fence height over 8 feet: 2.875-inch OD Type I round steel pipe
   2. Fence with PVC Slats
      a. Fence height of 8 feet or less: 2.875-inch OD Type I round steel pipe
      b. Fence height over 8 feet: 3.500-inch OD Type I round steel pipe

d. End, Corner, and Pull Posts:
   1. Fence without PVC Slats
      a. Fence height of 8 feet or less: 2.875-inch OD Type I round steel pipe
      b. Fence height over 8 feet: 3.500-inch OD Type I round steel pipe
   2. Fence with PVC Slats
      a. Fence height of 8 feet or less: 3.500-inch OD Type I round steel pipe
      b. Fence height over 8 feet: 4.000-inch OD Type I round steel pipe

e. Top Rail: Manufacturer's longest lengths (17 to 21 feet) with swedged-end or expansion-type coupling. Provide rail ends or other means for attaching top rail securely to each gate, corner, pull, and end post. 1.660-inch OD Type I round steel pipe.

f. Swing Gate Posts: Furnish posts to support single gate leaf, or one leaf of a double-gate installation, according to ASTM F 900, sized as follows for steel and pipe posts:

   1. Fence height of 6 feet or less and gate leaf width:
      a. 4 to 10 feet: 2.875-inch OD pipe
      b. Over 10 feet: 4.000-inch OD pipe
   2. Fence height over 6 feet and gate leaf width:
      a. Up to and including 6 feet: 2.875-inch OD pipe
      b. Over 6 to 12 feet: 4.000-inch OD pipe
      c. Over 12 to 18 feet: 6.625-inch OD pipe
      d. Over 18 to 24 feet: 8.625-inch OD pipe
      e. Over 24 to 40 feet: Double 4.000-inch OD pipes

4. Gate Frame Members:

a. Swing Gate Frame Members: Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. The

gate frame shall be constructed from same material and finish as fence framework, welded at all corners or assembled with corner fittings. Members are sized as follows for steel and pipe posts:

1. Gate height of 6 feet or less: 1.66-inch OD round pipe
2. Gate height over 6 feet: 1.90-inch OD round pipe

b. Truss Rods: Gate frames assembled with corner fittings shall have adjustable truss rods. 5/16-inch OD round pipe of the same metal and finish as the frame.

c. Interior Bracing: Gate leaf shall have vertical interior bracing at maximum intervals of 8 ft. and shall have a horizontal interior member if fabric height is 8 ft. or more. Additional horizontal, vertical or diagonal member or diagonal truss rods may be needed to comply with ASTM F 900 Section 5.2.1. 5/16-inch OD round pipe of the same metal and finish as the frame.

5. Fabric:

a. Steel Chain-Link Fence Fabric: Fabricated in one-piece widths for fencing 12 feet and less in height to comply with CLFMI "Product Manual" and with requirements indicated below:

1. Mesh and Wire Size: 2-inch mesh, 0.148-inch diameter (9 gage).
2. Coating: ASTM A 818, Type 1, 0.40 oz./ft^2 aluminum coating.
3. PVC Coating Color: Dark Green, complying with ASTM F934.

b. Chain-Link Gate Fabric: The fabric shall be the same as specified for fence. Secure fabric at vertical edges with tension bars and bands and to top and bottom of frame with tie wires.

6. Fittings and Accessories:

a. General: Comply with ASTM F 626. Mill-finished aluminum or galvanized iron or steel to suit manufacturer's standards. Unless specified otherwise, hot-dip galvanize pressed steel or cast-iron fence fittings and accessories with at least 1.2 oz. zinc per sq. ft. as determined by ASTM A 90.

b. Supplemental Color Coating: In addition to above metallic coatings, provide a 10-mil minimum polyvinyl chloride (PVC) or 3-mil minimum polyester plastic resin finish applied to exterior surfaces and, except inside cap shapes, to exposed interior surfaces. Color to match chain link fabric.

c. Post and Line Caps: Provide weather-tight closure cap for each post. Provide line post caps with loop to receive top rail.

d. Post Brace Assembly: Manufacturer's standard adjustable brace. 1.660-inch OD Type I round steel pipe for brace, and truss to line posts with 3/8-inch-diameter

rod and adjustable tightener. Provide manufacturer's standard galvanized-steel, cast-iron or cast-aluminum cap for each end.

e. Top Rail Sleeves: Rail sleeve material shall be a minimum of 0.051 in. in thickness, and a minimum of 6 in. in length. Rail sleeve must be fabricated to prevent movement along the rail.

f. Tension or Stretcher Bars: Hot-dip galvanized steel with a minimum length 2 inches less than the full height of fabric, a minimum cross section of 3/16 inch by 3/4 inch, and a minimum of 1.2 oz. of zinc coating per sq. ft. Provide one bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into the post.

g. Tension and Brace Bands: ¾-inch-wide minimum hot-dip galvanized steel with a minimum of 1.2 oz. of zinc coating per sq. ft.
   1. Tension Bands: 0.074 inch thick (14 gage) minimum.
   2. Brace Bands: 0.105 inch thick (12 gage) minimum.

h. Truss Rod Assembly: Steel rods shall be 5/16 in. diameter and it and all related devices shall be hot-dip galvanized after threading with a minimum of 1.2 oz. of zinc coating per sq. ft. Truss rod and tightener shall be capable of withstanding a tension of 2000 lb.

i. Tension Wire: 0.177-inch-diameter metallic-coated steel Marcelled tension wire conforming to ASTM A 824 with finish to match fabric. Coating shall be Type I aluminum with a minimum coating weight of 0.40 oz. per sq. ft. as determined by ASTM A 824.

j. Tie Wires and Clips: 0.148-inch diameter (9 gage) steel with a tensile strength range from 55 to 65 ksi with a minimum coating of 0.40 oz./ft2 of aluminum. Round metallic-coated steel tie wires, clips and hog rings shall withstand all forming or twisting operations without cracking or flaking of the aluminum coating. Bend ends of wire to minimize hazard to persons or clothing.

k. Privacy Slats: Winged-type, extruded PVC members of length to match fence height.
   1. Color: Green

7. Gate Hardware:

a. General: Provide galvanized hardware and accessories for each gate.

b. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180-degree gate opening. Provide 1-1/2 pair of hinges for each leaf over 6-foot nominal height.

c. Latch: Drop rod or plunger-bar type to permit operation from either side of gate, with padlock eye as an integral part of latch.

d. Keeper: Provide a keeper for vehicle gates that automatically engages gate leaf and holds it in the open position until manually released.

e. Gate Stops: Provide gate stops for double gates consisting of mushroom-type flush plate with anchors, set in concrete and designed to engage a center drop rod or plunger bar. Include a locking device and padlock eyes as an integral part of the latch, permitting both gate leaves to be locked with a single padlock.

f. Chain: Provide welded stainless steel, Type 347 0.375 dia. chain in lengths required as specified by the Engineer.

g. Locking Hardware:

1. Ring Bolts: Furnish and install 2 ring bolts, drop forged and hot galvanized as manufactured by Chicago Hardware and Fixture Company model 09527-3. These bolts shall be set to accept a padlock furnished by the Contractor. Ring bolts shall be bolted through gate frames and nuts welded to prevent removal.
2. Padlock: Furnish and install a padlock, as manufactured by Wilson Bohannan model 8625 or equal, to accept 7 pin small format interchangeable core. Padlock shall be non-key retained.
   a. Keying: Temporary 7 pin cores shall be furnished and installed by the contractor for these padlocks. Cores to be 626 finish in the Best / Falcon "A" keyway. Cores to be keyed 1335331 for an operating key and operated by a control key of 4118114.

PART 3 - EXECUTION

3.1 EXECUTION:

A. FENCE AND GATES

General: Install fence to comply with ASTM F 567, in the location indicated on the plans. Do not begin installation and erection before final grading is completed, unless otherwise permitted.

Excavation: Excavation and backfilling shall be performed as described herein and in accordance with Article 2.02.03 of Form 818.

a. Drill or hand-excavate (using post-hole digger) holes for all posts to diameters and spacings indicated, in firm, undisturbed or compacted soil. Excavate holes for each fence post to a minimum of 9 inches in diameter for all line posts and 12 inches in diameter for terminal, pull or corner posts, but not less than four times

the largest cross section of post. Excavate holes for all fence posts to depths not less than 40 inches below finish grade surface. Gate post holes shall comply with the following:

1. Gate width up to 12 feet: Excavate to a minimum diameter of 12 in. and a minimum depth of 40 in.
2. Gate width from 12 up to 18 feet: Excavate to a minimum diameter of 16 in. and a minimum depth of 46 in.
3. Gate width from 18 up to 24 feet: Excavate to a minimum diameter of 18 in. and a minimum depth of 52 in.
4. Gate width over 24 feet: Excavate holes for double posts to a 24 in. by 16 in. size hole with a minimum depth of 52 in.

Setting Posts: Center and align posts in holes 4 inches above bottom of excavation. Space a maximum of 10 feet o.c., unless otherwise indicated. Pull posts shall be provided where a change in vertical or horizontal alignment of ten (10) degrees or more occurs. Place concrete for the full depth of excavation, around all posts (including, but not limited to, line, corner and gate posts) and vibrate or tamp for consolidation. Unless otherwise indicated, extend concrete footings 2 inches above grade and trowel to a crown to shed water. Protect portion of posts above ground from concrete splatter. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.

Brace Assemblies: Install braces at end and gate posts and at both sides of corner and pull posts. Locate horizontal braces at mid-height of fabric on fences with top rail and at two thirds fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

Top Rails: Run rail continuously through line post caps for entire length of fence, terminating at rail end attached to posts or at post caps fabricated to receive rail. Provide expansion couplings as recommended by fencing manufacturer.

Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric before stretching fabric and tie to each post with not less than same gage and type of wire. Pull wire taut, without sags. Fasten to fabric with wire ties spaced a maximum of 24 inches o.c.

Fabric: Apply fabric to outside of the area enclosed. Leave approximately 2 inches between finish grade and bottom selvage. Place the fabric by securing one end and applying sufficient tension to remove all slack before making attachment elsewhere. Tighten the fabric to provide a smooth uniform appearance free from sag. Cut the fabric by untwisting a picket and attach each span independently at all terminal posts. Thread tension bars through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not over 15 inches o.c. Fasten fabric to the line posts at intervals not exceeding 15 in. Fasten fabric to the rail or tension wire at intervals not exceeding 24 in.

Privacy Slats: Install privacy slats according to manufacturer's instructions.

Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts for added security.

Gate Installation: Install gates, according to manufacturer's instructions, plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary. After repeated operation of completed installation equivalent to 3 days use by normal traffic, readjust gates and gate operators and controls for optimum operating condition and safety. Lubricate operating equipment and clean exposed surfaces.

END OF SECTION 304000

SECTION 305000 – TURF ESTABLISHMENT

PART 1 - GENERAL

1.1 SUMMARY:

A. TURF ESTABLISHMENT - LAWN: This work shall consist of providing an accepted stand of established grass by furnishing and placing seed as shown on the plans or ordered by the Engineer.

1.2 ACTION SUBMITTALS:

A. Submit the seed mixes in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. TURF ESTABLISHMENT - LAWN: The materials for this work shall conform to the requirements of Form 818 Article 9.50. The following mix shall be used:

In order to preserve and enhance the diversity, the source for seed mixtures shall be locally obtained within the Northeast USA including New England, New York, Pennsylvania, New Jersey, Delaware, or Maryland. One approved seed mixture is detailed. Other proposed mixtures must be approved by the ConnDOT Landscape Design office.

Proportion (%)	Species Common Name	Species Scientific Name
20	Abbey Kentucky Bluegrass	Poa pratensis
10	Envicta Kentucky Bluegrass	Poa pratensis
25	Pennlawn Red Fescue	Festuca rubra
15	Ambrose Chewing Fescue	Festuca rubra
30	Manhattan Ryegrass	Lolium perenne

PART 3 - EXECUTION

3.1 EXECUTION:

A. TURF ESTABLISHMENT - LAWN: Construction methods shall be those established as agronomically acceptable and feasible, and that are approved by the Engineer. Rate

of application shall be field determined in Pure Live Seed (PLS) based on the minimum purity and minimum germination of the seed obtained. Calculate the PLS for each seed species in the mix. Adjust the seeding rate for the above composition mix, based on 250 lbs/acre. The seed shall be mulched in accordance with Form 818 Article 9.50.03.

END OF SECTION 305000

SECTION 307000 – SANITARY/ DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. 8” Schedule 80 PVC
2. 6” Polyvinyl Chloride Pipe (Sanitary Sewer)
3. 8” Polyvinyl Chloride Pipe (Sanitary Sewer)
4. Manhole (Sanitary Sewer)
5. Manhole (Sanitary) with 4’ sump
6. Impervious Polyethylene Geomembrane Liner

1.2 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 818 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

1. Product Data: For each type of product indicated
2. Product Sample: Impervious Polyethylene Geomembrane Liner

1.3 PRODUCTS WARRANTY:

A. Refer to Form 818 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

B. Impervious Polyethylene Geomembrane Liner
1. Warranty and Guarantee: The manufacturer/installer shall provide a written guaranty to the Owner. As a minimum, the warranty shall stipulate that the material will be free from defects, and be able to withstand normal weathering and use from the date of installation for a period of twenty (20) years.

PART 2 -

2.1 MATERIALS:

A. 8” SCHEDULE 80 POLYVINYL CHLORIDE PIPE

1. The pipe shall meet the requirements of M.08.01-20 PVC Pipe and shall be Schedule 80.

2. Bedding: Bedding material shall comply with the requirements of Subarticle M.08.03-1, Form 818.

B. 6” POLYVINYL CHLORIDE PIPE (SANITARY SEWER):

1. PVC Pipe and Fittings: Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
   Bedding: Bedding material shall comply with the requirements of Subarticle M.08.03-1, Form 818.

C. 8” POLYVINYL CHLORIDE PIPE (SANITARY SEWER):

1. PVC Pipe and Fittings: Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
   Bedding: Bedding material shall comply with the requirements of Subarticle M.08.03-1, Form 818.

D. MANHOLE (SANITARY SEWER)

1. All materials shall comply with the requirements of Section 5.07 of Form 818 supplemented and amended as follows:
   a. Manhole covers and frames shall be water-resistant, bolted, 36” in diameter, rated for HS-20 loading requirements, and painted black.
   b. Manhole frames: Steel frame
   c. Manhole covers: Shall be marked with ¾” raised letters “SEWER”.
      1) In paved areas, manhole covers shall be steel.
      2) In all other areas fiberglass reinforced composite covers shall be used. Provide model No. FL90/HD as manufactured by Fiberlite or an approved equal.
   d. Include the following accessories: Lifting plate with 30 inch long lifting tool.
   e. Stainless steel bolts.

E. MANHOLE (SANITARY) WITH 4’ SUMP

1. All materials shall comply with the requirements of Section 5.07 of Form 818 supplemented and amended as follows:
   a. Manhole covers and frames shall be water-resistant, bolted, 36” in diameter, rated for HS-20 loading requirements, and painted black.
   b. Manhole frames: Steel frame
   c. Manhole covers: Shall be marked with ¾” raised letters “SEWER”.
      1) In paved areas, manhole covers shall be steel.

2) In all other areas fiberglass reinforced composite covers shall be used. Provide model No. FL90/HD as manufactured by Fiberlite or an approved equal.

d. Include the following accessories: Lifting plate with 30 inch long lifting tool.

e. Stainless steel bolts.

F. IMPERVIOUS POLYETHYLENE GEOMEMBRANE LINER:

1. Geomembrane Liner:

a. The membrane liner shall be comprised of a 30 Mil Impervious Polyethylene Geomembrane material manufactured of new, first-quality products designed and manufactured specifically for the purpose of liquid containment in hydraulic structures.

b. The liner materials shall be produced as to be free of holes, blisters, undispersed raw materials or any sign of contamination by foreign matter. Any such defect shall be repaired using the extrusion fusion welding technique in accordance with the manufacturer's recommendations.

c. The lining material shall be manufactured a minimum of 22.5 feet (6.8 meters) seamless widths. Label on the roll shall identify the thickness, length, and manufacturer's roll number.

d. The water quality pond lining system shall consist of a high quality formulation of high density polyethylene containing approximately 97.5% polymer and 2.5% of carbon black, anti-oxidants and heat stabilizers. The liner shall be designed specifically for exposed conditions.

e. The lining system shall be resistant to acids, alkalis, salts, alcohols, amines, oils and other hydrocarbons.

2. Sand Bedding and Cover: The materials used for the sand bedding layer shall be sand or sandy soil, all of which passes a 3/8" sieve and not more than 10% passes a no. 200 sieve.

PART 3 - EXECUTION

3.1 EXECUTION:

A. 8” SCHEDULE 80 POLYVINYL CHLORIDE PIPE

1. Refer to Form 818 Article 05.13.03 for requirements related to this work.

B. 6” POLYVINYL CHLORIDE PIPE (SANITARY SEWER):

1. General: Do not store plastic pipe and fittings in direct sunlight. Protect pipe, pipe fittings, and seals from dirt and damage. Support during storage to prevent sagging and bending.

2. Excavation: Excavation and backfilling shall be performed as described herein and in accordance with Article 2.05.03 of Form 818.
3. Bedding: Placement of bedding material shall comply with Form 818 Section 6.51.
4. PVC Pipe: Basic piping joint construction is specified in CSI Division 22 Section 220500, "Common Work Results for Plumbing". Where specific joint construction is not indicated, follow piping manufacturer's written instructions. Install piping in accordance with ASTM D 2321. Make changes in direction using appropriate branches, bends, and long sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of piping in direction of flow is prohibited. Join PVC piping with solvent-cemented joints in accordance with ASTM D 2855, with solvent cement conforming to ASTM D 2564 and primer conforming to ASTM F656. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops. Install sleeves for piping passing under building foundations.
5. Cleaning: Clean interior of piping. Remove dirt and debris as work progresses. Flush with potable water.
6. Testing: Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   a. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   b. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   c. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   d. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
   e. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   f. Prepare reports for tests and required corrective action.

C. 8” POLYVINYL CHLORIDE PIPE (SANITARY SEWER):

1. General: Do not store plastic pipe and fittings in direct sunlight. Protect pipe, pipe fittings, and seals from dirt and damage. Support during storage to prevent sagging and bending.
2. Excavation: Excavation and backfilling shall be performed as described herein and in accordance with Article 2.05.03 of Form 818.
3. Bedding: Placement of bedding material shall comply with Form 818 Section 6.51.
4. PVC Pipe: Basic piping joint construction is specified in CSI Division 22 Section 220500, "Common Work Results for Plumbing". Where specific joint construction is not indicated, follow piping manufacturer's written instructions. Install piping in accordance with ASTM D 2321. Make changes in direction using appropriate branches, bends, and long sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of piping in direction of flow is prohibited. Join PVC piping with solvent-cemented joints in accordance with ASTM D 2855, with solvent cement conforming to ASTM D 2564 and primer conforming to ASTM F656. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops. Install sleeves for piping passing under building foundations.
5. Cleaning: Clean interior of piping. Remove dirt and debris as work progresses. Flush with potable water.
6. Testing: Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
    a. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
    b. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
    c. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
    d. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
    e. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

f. Prepare reports for tests and required corrective action.

D. MANHOLE (SANITARY SEWER):

1. Comply with methods outlined in Section 5.07 of Form 818.
2. Installation of manhole frames and grates shall conform to manufacturer's recommendations.

E. MANHOLE (SANITARY) WITH 4' SUMP:

1. Comply with methods outlined in Section 5.07 of Form 818.
2. Installation of manhole frames and grates shall conform to manufacturer's recommendations.

F. END OF SECTION 307000 IMPERVIOUS POLYETHYLENE GEOMEMBRANE LINER:

1. Area Subgrade Preparation: Surfaces to be lined should be smooth and free of all rocks, stones, sticks, roots, sharp objects, or debris of any kind. The surface shall provide a firm, unyielding foundation for the membrane with no sudden, sharp or abrupt changes or break in grade. No standing water or excessive moisture shall be allowed. The Contractor shall certify in writing that the surface on which the membrane is to be installed is acceptable before commencing work.
2. The Contractor shall install a minimum of 4" thick sand layer below and above the proposed liner. The purpose of the sand layer is to provide that liner with a flat, smooth bearing surface. Fill all voids below liner.
3. The installation of the IPG Liner must be done by the manufacturer using the manufacturer's extrusion or hot wedge equipment and installation methods. All supervisors overseeing the liner installation must have ten million square feet of supervisory liner experience. All field technicians must have over one million square feet of seaming experience.
4. Field Seams: Individual panels of liner material shall be laid out and overlapped by a maximum of four inches for extrusion weld prior to welding or five inches for hot wedges weld prior to welding. Extreme care shall be taken by the installer in the preparation of the area to be welded. The area to be welded shall be cleaned and prepared according to the procedures specified by the material manufacturer. All sheeting shall be welded together by means of integrating the extruded bead with the lining material. The composition of the extruded bead shall be identical to the lining material, or all sheeting shall be welded together using the hot wedge welding system.
5. The welding equipment used shall be capable of continuously monitoring and controlling the temperatures in the zone of contact where the machine is actually fusing the lining material so as to ensure that changes in environmental conditions will not affect the integrity of the weld.
6. No "fish mouths" shall be allowed within the seam area. Where "fish mouths" occur, the material shall be cut, overlapped, and an overlap extrusion weld shall be applied.

7. The Contractor shall deliver and install one 4" layer of sand cover material over the entire surface of the liner. The Contractor shall take the necessary precautions to protect the Liner during installation of cover material. The use of tracked equipment within the liner limits will be prohibited. Any damage to the liner caused due to the placement of the cover material or any other construction related activity will be repaired by the Contractor at no additional cost to the Owner.
8. Field Seam Testing/Quality Control:
   a. The installer shall employ on-site physical nondestructive testing on all welds.
   b. A quality control technician shall inspect each seam. Any area showing a defect shall be marked and repaired in accordance with HDPE repair procedures.
   c. A test weld three (3) feet long from each welding machine shall be run each day prior to line welding and under the same conditions as exist for the liner welding. The test weld shall be marked with date, ambient temperature, and welding machine number. Samples of weld ¼" to ½" wide shall be cut from the test weld and pulled by hand in peel. The weld should not peel. Seams should exhibit a film tear bond. The weld sample shall be kept subsequent testing on laboratory tensionmeter equipment in accordance with the applicable ASTM standard. Random weld samples may be removed from the installed welded sheeting at a frequency to be agreed (e.g., 1/500' of weld).

END OF SECTION 307000

PERMITS AND/OR REQUIRED PROVISIONS:

The following Permits and/or and Required Provisions follow this page are hereby made part of this Contract.

- **PERMITS AND/OR PERMIT APPLICATIONS**

  DEEP General Stormwater and Dewatering
  from Construction Activities Permit Registration is prior to Notice to Proceed

- **Construction Contracts - Required Contract Provisions (State Funded Only Contracts)**

Connecticut Department of
Energy & Environmental Protection
Bureau of Materials Management & Compliance Assurance
Water Permitting & Enforcement Division

General Permit Registration Form for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, effective 10/1/13 (electronic form)

Prior to completing this form, you **must** read the instructions for the subject general permit at **DEEP-WPED-INST-015**.
This form must be filled out electronically before being printed.
You must submit the registration fee along with this form.

The status of your registration can be checked on the DEEP's ezFile. Portal. Please note that DEEP will no longer mail certificates of registration.

CPPU USE ONLY	
App #:	
Doc #:	
Check #:	
Program:	Stormwater

Part I: Registration Type

Select the appropriate boxes identifying the registration type and registration deadline.

Registration Type			Registration Timeline	
☐	**Re-registration** **Existing Permit No. GSN** _____		**On or before February 1, 2014*** *Note: Failure to renew a permit by this date will require submission of new registration. Re-registrants must only complete Parts I, II, III, IV - Question 1, VII and submit Attachment A.	
☑	**New Registration** (Refer to Section 2 of the permit for definitions of Locally Exempt and Locally Approvable Projects)	☐ **Locally Approvable** **Size of soil disturbance:** _____	**New registration - Sixty (60) days prior to the initiation of the construction activity for:** For sites with a total soil disturbance area of 5 or more acres	
		☑ **Locally Exempt** **Size of soil disturbance:** 7.54	☑	**New registration - Sixty (60) days prior to the initiation of the construction activity for:** Sites with a total disturbance area of one (1) to twenty (20) acres except those with discharges to impaired waters or tidal wetlands
			☐	**New registration - Ninety (90) days prior to the initiation of the construction activity for:** (i) Sites with a total soil disturbance area greater than twenty (20) acres, or (ii) Sites discharging to a tidal wetland (that is not fresh-tidal and is located within 500 feet), or (iii) Sites discharging to the impaired water listed in the "Impaired Waters Table for Construction Stormwater Discharges"

Part II: Fee Information

1. New Registrations

   a. Locally approvable projects (registration only):

☐ $625

   b. Locally exempt projects (registration and Plan):

☑ $3,000 total soil disturbance area ≥ one (1) and < twenty (20) acres.

☐ $4,000 total soil disturbance ≥ twenty (20) acres and < fifty (50) acres.

☐ $5,000 total soil disturbance ≥ fifty (50) acres.

2. Re-Registrations

☐ $625 (sites previously registered prior to September 1, 2012)

☐ $0 (sites previously registered between to September 1, 2012 and effective date of this permit)

Total Fee: $3,000.00

The fees for municipalities shall be half of those indicated in subsections (a), (b) and (c) above pursuant to Section 22a-6(b) of the Connecticut General Statutes. State and Federal agencies shall pay the full fees specified in this subsection. The registration will not be processed without the fee. The fee shall be non-refundable and shall be paid by certified check or money order payable to the Department of Energy and Environmental Protection.

Part III: Registrant Information

- If a registrant is a corporation, limited liability company, limited partnership, limited liability partnership, or a statutory trust, it must be registered with the Secretary of the State. If applicable, the registrant's name shall be stated **exactly** as it is registered with the Secretary of the State. This information can be accessed at **CONCORD**
- If a registrant is an individual, provide the legal name (include suffix) in the following format: First Name; Middle Initial; Last Name; Suffix (Jr, Sr., II, III, etc.).

1. Registrant /Client Name: STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION

   Registrant Type: State Agency

   Secretary of the State business ID #:

   Mailing Address: 2800 Berlin Tpke

   City/Town: Newington State: CT Zip Code: 06111

   Business Phone: (860)823-3204 ext.:

   Example:(xxx) xxx-xxxx

   Contact Person: Robert E. Obey, P.E. Title : District 2 Engineer

   E-Mail: robert.obey@ct.gov

2. List billing contact:

   Name: STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION

   Mailing Address: 2800 BERLIN TPKE

   City/Town: NEWINGTON State: CT Zip Code: 06111

   Business Phone: (860)823-3204 ext.:

   Contact Person: Robert E. Obey, PE Title : District 2 Engineer

3. List primary contact for departmental correspondence and inquiries:

Name: STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION

Mailing Address: 2800 Berlin Tpke

City/Town: Newington State: CT Zip Code: 06111

Business Phone: (860)823-3204 ext.

Contact Person: Robert E. Obey, P.E. Title: District 2 Engineer

4. List owner of the property on which the activity will take place:

Name: STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION

Mailing Address: 2800 Berlin Tpke

City/Town: Newington State: CT Zip Code: 06111

Business Phone: (860) 594-2229 ext.

Contact Person: David Hartley

5. List preparer:

Name: STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION

Mailing Address: 2800 BERLIN TPKE

City/Town: NEWINGTON State: CT Zip Code: 06111

Business Phone: (860) 594-3306 ext.

Contact Person: Michael Strong Title: Supervisor

6. List design professional:

Name: BL COMPANIES, INC.

Mailing Address: 100 CONSTITUTION PLZ, 10TH FL

City/Town: HARTFORD State: CT Zip Code: 06103

Business Phone: (860) 760-1918 ext.

Contact Person: Michael Fisher, PE Title: Senior Project Manager

7. List Reviewing Qualified Professional (for locally approvable projects only):

Name:

Mailing Address:

City/Town: State: Zip Code:

Business Phone: ext.

Contact Person: Title:

Part IV: Site Information

1. Site Name: Pr #115-121- Putnam Repair & Maint. Facilities

Street Address or Description of Location: 3 Industrial Park Rd

City/Town: Putnam State: CT Zip Code: 06260

Brief Description of construction activity:

The project will entail the building of a new Repair facility and Maintenance facility, and two cold storage building.

Project Start Date: 21 Jan 2021 Anticipated Completion Date: 27 Nov 2023

Normal working hours: 8:30 to 3:00

2. **MINING** : Is the activity on the site in question part of mining operations (i.e. sand and gravel)? ☐Yes ☑No

If yes, mining is not authorized by this general permit. You must submit the Registration Form for the General Permit for the Discharge of Stormwater Associated with Industrial Activity.

3. **COMBINED OR SANITARY SEWER:** Does all of the stormwater from the proposed activity discharge to a combined or sanitary sewer (i.e. a sewage treatment plant)? ☐ Yes ☑No

If yes, this activity is not regulated by this permit. Contact the Water Permitting & Enforcement Division at 860-424-3018.

4. **INDIAN LANDS:** Is or will the facility be located on federally recognized Indian lands? ☐ Yes ☑No

5. **COASTAL BOUNDARY:** Is the activity which is the subject of this registration located within the coastal boundary as delineated on DEEP approved coastal boundary maps? ☐ Yes ☑No

The coastal boundaries fall within the following towns: Branford, Bridgeport, Chester, Clinton, Darien, Deep River, East Haven, East Lyme, Essex, Fairfield, Greenwich, Groton (City and Town), Old Lyme, Guilford, Hamden, Ledyard, Lyme, Madison, Milford, Montville, New London, New Haven, North Haven, Norwalk, Norwich, Old Saybrook, Orange, Preston, Shelton, Stamford, Stonington (Borough and Town), Stratford, Waterford, West Haven, Westbrook and Westport.

If "yes", and this registration is for a new authorization or a modification of an existing authorization where the physical footprint of the subject activity is modified, you must provide documentation to the DEEP Office of Long Island Sound Programs or the local governing authority has issued a coastal site plan approval or determined the project is exempt from coastal site plan review. Provide this documentation with your registration as Attachment B. See guidance in Appendix D of the general permit. Information on the coastal boundary is available at the local town hall or on the **Connecticut Coastal Resources Map** . Additional DEEP Maps and Publications are available by contacting DEEP Staff at 860-424-3555.

6. **ENDANGERED OR THREATENED SPECIES:**

In order to be eligible to register for this General permit, each registrant must either perform a self-assessment, obtain a limited one-year determination, or obtain a safe-harbor determination regarding threatened and endangered species. This may include the need to develop and implement a mitigation plan. While each alternative has different limitations, the alternatives are not mutually exclusive; a registrant may register for this General Permit using more than one alternative, See Appendix A of the general Permit. Each registrant must complete this AND Attachment C to this Registration form and a registrant who does not or cannot do so is not eligible to register under this General Permit.

Each registration must perform a review of the Department's Natural Diversity Database maps to determine if the site of the construction activity is located within or in proximity (within ¼ mile) to a shaded area.

a. Provide the date of the NDDB maps were reviewed: 12 May 2020 (Print a copy of the NDDB map you viewed since it must be submitted with this registration as part of Attachment C.)

b. For a registrant using a limited one-year determination or safe harbor determination to register for this General Permit, provide the Department's Wildlife Division NDDB identification number for any such determination:

201912142 (The number is on the determination issued by the Department's Wildlife Division).

For more information on threatened and endangered species requirements, refer to Appendix A and section 3(b)(2) of this General Permit, Visit the DEEP website at **Natural Diversity Data Base** or call the NDDB at 860-424-3011.

c. I verify that I have completed Attachment C to this Registration Form. ☑ Yes

7. **WILD AND SCENIC RIVERS:** Is the proposed project within the watershed of a designated Wild and Scenic River? (See Appendix H for guidance) ☐ Yes ☑ No

8. **AQUIFER PROTECTION AREAS:** Is the site located within a mapped **Aquifer Protection Area** , as defined in Section 22a-354h of the CT General Statutes? (For additional guidance, please refer to Appendix C of the General Permit) ☑ Yes ☐ No

9. **Connecticut Guidelines for Soil Erosion and Sediment Control Guidelines:** Is the activity in accordance with Connecticut Guidelines for Soil Erosion and Sediment Control Guidelines and local erosion & sediment control ordinances, where applicable? ☑ Yes ☐ No

10. **HISTORIC AND/OR ARCHAEOLOGICAL RESOURCES:**

Has the site of the proposed activity been reviewed (using the process outlined in Appendix G of this permit) for historic and/or archaeological resources? ☑ Yes ☐ No

a. The review indicates the proposed site does not have the potential for historic/ archaeological resources, OR ☑ Yes ☐ No

b. The review indicated historic and/ or archaeological resource potential exists and the proposed activity is being or has been reviewed by the Offices of Culture and Tourism, OR ☐ NA ☐ Yes ☑ No

c. The proposed activity has been reviewed and authorized under an Army Corps of Engineers Section 404 wetland permit. ☐ NA ☐ Yes ☑ No

11. **CONSERVATION OR PRESERVATION RESTRICTION:**

Is the property subject to a conservation or preservation restriction? ☐ Yes ☑ No

If Yes, proof of written notice of this registration to the holder of such restriction or a letter from the holder of such restriction verifying this registration is in compliance with the terms of the restriction, must be submitted as Attachment D.

Part V: Stormwater Discharge Information

Table 1

Outfall #	a) Type	b) Pipe Material	c) Pipe Size	d) Note: To find lat/long, go to: CT ECO . A decimal format is required here. Directions on how to use CT ECO to find lat. /long. and conversions can be found in in Part V, section d of the DEEP-WPED-INST-015 .		e) What method was used to obtain your latitude/longitude information?
				Longitude *(Format: -xx.xxxxx)*	Latitude *(Format: xx.xxxxx)*	
EO-2	Pipe	Concrete	36"	-71.890696	41.899543	ezFile Portal Map
EO-1	Pipe	Concrete	18"	-71.889408	41.899128	ezFile Portal Map
EO-3	Swale			-71.890696	41.899543	ezFile Portal Map
EO-4	Swale			-71.890696	41.899543	ezFile Portal Map

Part V: Stormwater Discharge Information Continued

Table 2

2. Provide the following information about the receiving water(s)/wetland(s) that receive stormwater runoff from your site, either directly or through the storm sewer system:							
Outfall #	**Dates when this outfall will be active:**	**a) To what system or receiving water does your stormwater runoff discharge? either "storm sewer or wetlands" or "waterbody" (If you select storm sewer or wetlands, columns c.1&2 of this table are not required to be completed)**	**b) What is your watershed ID (freshwater) or 305b ID (estuary)? (Section 3.b, of the DEP-GP-INST-015 explains how to find this information)**	**c.1) Is your receiving water identified as an impaired water in the "Impaired Waters Table for Construction Stormwater Discharges"?**	*If you answered yes to question c.1, then answer the question below* **c.2) Has any Total Maximum Daily Load (TMDL) been approved for your receiving waterbody?**	**For the drainage area associated with each outfall: Effective Impervious Area Before Construction (sq ft)**	**For the drainage area associated with each outfall: Effective Impervious Area After Construction (sq ft)**
EO-2	Start: 27 Jan 2021 End:	Storm Sewer or Wetlands		☐ Y ☐ N ☑ NA	☐ Y ☐ N ☑ NA	72745	109335
EO-1	Start: 27 Jan 2021 End:	Waterbody		☐ Y ☐ N ☑ NA	☐ Y ☐ N ☑ NA	60548	63597
EO-3	Start: 27 Jan 2021 End:	Storm Sewer or Wetlands		☐ Y ☐ N ☑ NA	☐ Y ☐ N ☑ NA	41382	53578
EO-4	Start: 27 Jan 2021 End:	Storm Sewer or Wetlands		☐ Y ☐ N ☑ NA	☐ Y ☐ N ☑ NA	33541	7405
	Start: End:	Select One		☐ Y ☐ N ☐ NA	☐ Y ☐ N ☐ NA		
Provide the total effective impervious area for the entire site(sq ft):						208216	233915

Part V: Stormwater Discharge Information (continued)

Impaired waters: If you answered "yes" to Table 2, question 2.c.1, **verify** that the project's Pollution Control Plan (Plan) addresses the control measures below in Question 1 or 2, as appropriate.

1. **If the impaired water does not have a TMDL,** confirm compliance by selecting 1.a. or 2.b. below:

   a. No more than 3 acres is disturbed at any time; ☐ Yes

   OR

   b. Stormwater runoff from a 2 yr, 24 rain event is **retained.** ☐ Yes

2. **If the impaired water has a TMDL,** confirm compliance by selecting 2.a. and 2.b. below and either question 2.c.1. or 2.c.2. below:

   a. The Plan documents there is sufficient remaining Waste Load Allocations (WLA) in the TMDL for the proposed discharge, ☐ Yes

   AND

   b. Control measures shall be implemented to assure the WLA will not be exceeded, ☐ Yes

   AND

   c. 1. Stormwater discharges will be monitored for the indicator pollutant identified in the TMDL, ☐ Yes

   OR

   2. The Plan documents specific requirements for stormwater discharges specified in the TMDL. ☐ Yes

Part VI: Pollution Control Plan Availability (check one of the following four categories)

☑ I am registering a Locally Exempt project and submitting the required electronic Plan (in Adobe™ PDF or similarly publically available format) pursuant to Section 3(c)(2)(E) of this permit.

- ☑ Plan is attached to this registration form
- ☐ Plan is available at the following Internet Address (URL): _____

☐ I am registering a Locally Approvable project and have chosen not to submit the Plan with this registration pursuant to Section 3(c)(1) of this permit.

☐ I am registering a Locally Approvable project and have chosen to make my Plan electronically available pursuant to Section 4(c)(2)(N) of this permit.

- ☐ Plan is attached to this registration form
- ☐ Plan is available at the following Internet Address (URL): _____

☐ I am registering a Locally exempt project and do not have the capability to submit the Plan electronically. Therefore, I am submitting a paper copy with this registration as Attachment E.

Part VII: Registrant Certification

The registrant *and* the individual(s) responsible for actually preparing the registration must sign this part. A registration will be considered incomplete unless all required signatures are provided.

For New Registrants:

"I hereby certify that I am making this certification in connection with a registration under such general permit, submitted to the commissioner by E OF CONNECTICUT DEPARTMENT OF TRANSPORTA for an activity located at 3 Industrial Park Rd, Putnam, CT 06260 and that all terms and conditions of the general permit are being met for all discharges which have been initiated and such activity is eligible for authorization under such permit. I further certify that a system is in place to ensure that all terms and conditions of this general permit will continue to be met for all discharges authorized by this general permit at the site. I certify that the registration filed pursuant to this general permit is on complete and accurate forms as prescribed by the commissioner without alteration of their text. I certify that I have personally examined and am familiar with the information that provides the basis for this certification, including but not limited to all information described in Section 3(b)(8)(A) of such general permit, and I certify, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining such information, that the information upon which this certification is based is true, accurate and complete to the best of my knowledge and belief. I certify that I have made an affirmative determination in accordance with Section 3(b) (8) (B) of this general permit. I understand that the registration filed in connection with such general permit is submitted in accordance with and shall comply with the requirements of Section 22a-430b of Connecticut General Statutes, as amended by Public Act 12-172. I also understand that knowingly making any false statement made in the submitted information and in this certification may be punishable as a criminal offense, including the possibility of fine and imprisonment, under Section 53a-157b of the Connecticut General Statutes and any other applicable law."

For Re-registrants:

"I hereby certify that I am making this certification in connection with a registration under the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, submitted to the commissioner by _____ for an activity located at _____ and that all terms and conditions of the general permit are being met for all discharges which have been initiated and such activity is eligible for authorization under such permit. I further certify that all designs and plans for such activity meet the current terms and conditions of the general permit in accordance with Section 5(b)(5)(C) of such general permit and that a system is in place to ensure that all terms and conditions of this general permit will continue to be met for all discharges authorized by this general permit at the site. I verify that the registration filed pursuant to this general permit is on complete and accurate forms as prescribed by the commissioner without alteration of their text. I certify that I have personally examined and am familiar with the information that provides the basis for this certification, including but not limited to all information described in Section 3(b)(8)(A) of such general permit, and I certify, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining such information, that the information upon which this verification is based is true, accurate and complete to the best of my knowledge and belief. I also understand that knowingly making any false statement made in the submitted information and in this certification may be punishable as a criminal offense, including the possibility of fine and imprisonment, under Section 53a-157b of the Connecticut General Statutes and an other applicable law."

Signature of Registrant	
Robert E. Obey, P.E.	District 2 Engineer
Name of Registrant (print or type)	Title (if applicable)
Signature of Preparer and Date (if different than above)	
Michael Strong	Supervisor
Name of Preparer (print or type)	Title (if applicable)

Part VIII: Professional Engineer (or Landscape Architect, where appropriate) Design Certification (for publically approvable and exempt projects)

The following certification must be signed by a Professional Engineer, or Landscape Architect where appropriate.

"I hereby certify that I am a licensed in the State of Connecticut.
I am making this certification in connection with a registration under such general permit, submitted to the commissioner by STATE OF CONNECTICUT DEPARTMENT OF TRANSPORTATION for an activity located at 3 Industrial Park Rd, Putnam, CT 06260 .
I certify that I have thoroughly and completely reviewed the Stormwater Pollution Control Plan for the project or activity covered by this certification. I further certify, based on such review and on the standard of care for such projects, that the Stormwater Pollution Control Plan has been prepared in accordance with the Connecticut Guidelines for Soil Erosion and Sediment Control, as amended, the Stormwater Quality Manual, as amended, and the conditions of the general permit, and that the controls required for such Plan are appropriate for the site. I further certify, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining such information, that the information upon which this certification is based is true, accurate and complete to the best of my knowledge and belief. I also understand that knowingly making any false statement in this certification may subject me to sanction by the Department and/or be punishable as a criminal offense, including the possibility of fine and imprisonment, under Section 53a-157b of the Connecticut General Statutes and any other applicable law."

Signature of Design Professional and Date	
Michael Fisher, PE	21170
Name of Professional (print or type)	License Number
Affix P.E/L.A Stamp Here	

Part IX: Reviewing Qualified Professional Certification

The following certification must be signed by a) a Conservation District reviewer OR, b) a qualified soil erosion and sediment control and/ or professional engineer

☐ **Review Certification by Conservation District:**

1.) District: _____

Date of Affirmative Determination: _____

" I am making this certification in connection with a registration under General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, submitted to the commissioner by _____ for an activity located at _____.
I have personally examined and am familiar with the information that provides the basis for this certification, and I affirm, based on the review described in Section 3(b)(11)(C) of this general permit and on the standard of care for such projects, that the Stormwater Pollution Control Plan is adequate to assure that the activity authorized under this general permit will comply with the terms and conditions of such general permit and that all stormwater management systems: (i) have been designed to control pollution to the maximum extent achievable using measures that are technologically available and economically practicable and that conform to those in the Guidelines and the Stormwater Quality Manual; (ii) will function properly as designed; (iii) are adequate to ensure compliance with the terms and conditions of this general permit; and (iv) will protect the waters of the state from pollution."

_____

Signature of District Professional and Date

_____ _____

Name of District Professional License Number (if applicable)

Or

☐ **Review Certification by Qualified Professional:**

Company Name: _____

Name: _____

License #: _____

Level of independency of professional:

Required for all projects disturbing over 1 acre:

1. I verify I am not an employee of the registrant. ☐ Yes
2. I verify I have no ownership interest of any kind in the project for which the registration is being submitted. ☐ Yes

Required for projects with 15 or more acres of site disturbance (in addition to questions 1&2):

3. I verify I did not engage in any activities associated with the preparation, planning, designing or engineering of the soil erosion and sediment control plan or stormwater management systems plan for this registrant. ☐ Yes
4. I verify I am not under the same employ as any person associated with the preparation, planning, designing or engineering of the soil erosion and sediment control plan or stormwater management systems plan for this registrant. ☐ Yes

Part IX: Reviewing Qualified Professional Certification (continued)

"I hereby certify that I am a qualified professional engineer or qualified soil erosion and sediment control professional, or both, as defined in the General Permit for Discharge of Stormwater and Dewatering Wastewaters from Construction Activities and as further specified in Sections 3(b)(11)(A) and (B) of such general permit. I am making this certification in connection with a registration under such general permit, submitted to the commissioner by _____ for an activity located at _____ .
I have personally examined and am familiar with the information that provides the basis for this certification, including but not limited to all information described in Section 3(b)(11)(C) of such general permit, and I certify, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining such information, that the information upon which this certification is based is true, accurate and complete to the best of my knowledge and belief. I certify, based on my review of all information described in Section 3(b)(11)(C) of such general permit and on the standard of care for such projects, that I have made an affirmative determination in accordance with Sections 3(b)(11)(D)(i) and (ii) of this general permit. I understand that this certification is part of a registration submitted in accordance with Section 22a-430b of Connecticut General Statutes, as amended by Public Act 12-172, and is subject to the requirements and responsibilities for a qualified professional in such statute. I also understand that knowingly making any false statement in this certification may be punishable as a criminal offense, including the possibility of fine and imprisonment, under Section 53a-157b of the Connecticut General Statutes and any other applicable law."

_____

Signature of Reviewing Qualified Professional

_____ _____

Name of Reviewing Qualified Professional License No.

Affix P.E./ L.A. Stamp Here

Note: Please submit the fee along with a completed, printed and signed Registration Form and all additional supporting documents to:

CENTRAL PERMIT PROCESSING UNIT
DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION
79 ELM STREET
HARTFORD, CT 06106-5127

STORMWATER POLLUTION CONTROL PLAN

Putnam Repair Facility and Maintenance Facility
Putnam, CT

State Project No.: 115-121
EzFile No. 61646

Connecticut Department of Transportation

May 2020

This Stormwater Pollution Control Plan (SPCP) is prepared to comply with the requirements for the General Permit for Stormwater Discharges (GPSD) from Construction Activities. Also to be considered part of the SPCP are the proposed construction plans, special provisions, and the Connecticut Department of Transportation's "Standard Specifications for Roads, Bridges and Incidental Construction" (Form 817) including supplements thereto and the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control

Table of Contents

1. Site Description

Site Description

The project will entail the building of a new Repair facility and Maintenance facility, and two cold storage building on 3 Industrial Park Rd in Putnam, CT. The purpose of project is to replace a functionally obsolete and non-compliant facility with two new facilities that will be in compliance with the applicable portion of the "Major Capital Program Design Manual" and existing agreements between the DOT and DEEP. No work will occur within the delineated wetland area. The floodplain has been delineated within the contract plan sheets and no work will occur within the floodplain. The project site is located within a designated APA and appropriate measures (canopies over fuel island and oil water separator in the vehicle laydown parking area) have been implemented in conjunction with our Environmental Compliance working with CT DEEP.

Site work includes grading, utilities replacement, replacement of two cold storage buildings, and corresponding site improvements.

Estimated Disturbed Area

The total area for this project site is 7.65 acres. Of this area, 7.54 acres of erodible soil will be disturbed by construction activities. 0.11 acres will be considered non- erodible disturbance.

Estimated Runoff Coefficient

The runoff coefficient assumed for the building's roof is 1.0, for pavement is 0.9, and for gravel/ rip rap areas is 0.45. For the pervious areas (turf), a coefficient of 0.2 to 0.4 is assumed. The weighted runoff coefficient for the site has been raised from 0.73 to 0.76.

Pre-Construction

$$\frac{(0.25 \text{ ac. x } 0.2)+(0.14 \text{ ac x } 0.3)+(2.29 \text{ ac. x } .4)+(4.38 \text{ ac. x } .9)+(.69 \text{ ac. x } 1.0)}{7.75 \text{ ac.}} = \mathbf{0.73}$$

Post-Construction

$$\frac{(1.19 \text{ ac. x } 0.3)+(0.17 \text{ ac x } 0.4)+(.9 \text{ ac. x } .45)+(4.21 \text{ ac. x } .9)+(1.28 \text{ ac. x } 1.0)}{7.75 \text{ ac.}} = \mathbf{0.76}$$

The estimated runoff coefficients, with the corresponding contributing areas, are shown on

Figures 3 and 4.

The overall AI (acreage multiplied by an impervious runoff coefficient) for the site was marginally raised from 5.66 to 5.89.

Receiving Waters

The site stormwater runoff sheet flows over the site and is directed via piping to two stormwater basins/ forebays (primary treatment) before entering Culver Brook. The next receiving body is the Quinebaug River.

Extent of Wetlands on Site

The site has no wetlands within the construction limits. The site has peripheral wetlands outside the construction limits.

2. Construction Sequencing

The Contractor will be given approximately eight months for the construction of all phases of the project.

The suggested sequence of construction is as follows:

1. Conduct a preconstruction meeting.
2. Install erosion controls at the effected inlets and at limits of disturbed slopes and construct detention basins/ forebays. Please note- Silt fencing protecting wetland delineated areas will be marked in some manner to indicate and prevent inadvertent entrance to wetland areas.
3. Perform clearing and grubbing activities.
4. **Note- the detention basins/ forebays with rip rap must be in place before any other excavation work can take place.**
5. Apply temporary stabilization measures for disturbed areas in accordance with pages 5-6, Temporary Stabilization Practices.
6. Install site utilities, drainage, and pavement structure.
7. Grade grass slopes and immediately stabilize. Establish turf, per contract, on all remaining disturbed areas. Rip rap will be used before discharge points for sediment control.
8. Remove erosion controls when it is determined that disturbed areas have been stabilized. (This determination will be made by the Qualified Inspector).
9. All post-construction stormwater structures shall be cleaned of construction sediment and any remaining silt fence shall be removed prior to the filing of the "Notice of Termination Form".
10. Perform project cleanup.

It is anticipated that the construction of the two facilities will take 30 months. If the construction sequencing activities create an area of disturbance with a total contributing drainage area of between two (2) acres and five (5) acres per discharge point, a temporary sediment trap must be provided and the Contractor must submit to the Engineer a revised SWPCP for review and approval. The SWPCP must include locations of the temporary sedimentation trap per discharge point with a capacity to contain 134 cubic yards per acre of material in accordance with the 2002 CT Erosion and Sedimentation Guidelines (2002 Guidelines). The Contractor shall provide an inspection and maintenance plan for the temporary sedimentation trap as part of the amended SWPCP.

If the areas of disturbance with a total contributing drainage area of more than five (5) acres per discharge point, a temporary engineered sedimentation basin must be provided and the Contractor must submit to the Engineer a revised SWPCP for review and approval. The SWPCP must include locations of the temporary engineered sedimentation basin designed and installed in accordance with the 2002 Guidelines. The Contractor shall provide an inspection and maintenance plan or the engineered sedimentation basin as part for the amended SWPCP.

3. Control Measures

Erosion and Sedimentation Controls

The Department of Transportation (Department) will have a qualified inspector assigned to the project in order to oversee the Contractor's operations to ensure compliance with the provisions of the Contract. Further Department oversight is provided by the District *2* Environmental Coordinator and the Office of Environmental Planning.

The following timelines will be followed for the proposed construction activities:

- If construction activities are completed to final grade, permanent seeding shall take place within seven (7) days.

- Areas that remain disturbed but inactive for at least 30 days shall receive temporary seeding or soil protection within seven (7) days.

- Areas that will be disturbed past the planting season will be covered with a long-term, non-vegetative stabilization method that will provide protection through the winter.

- The Contractor shall stabilize disturbed areas with temporary or permanent measures as quickly as possible after the land is disturbed. Requirements for soil stabilization are detailed in Form 817 Section 1.10, Environmental Compliance.

Soil Stabilization and Protection

Temporary Stabilization Practices

- Erosion Control Matting: On turf slopes steeper than 2:1 erosion control matting shall be used to stabilize the topsoil or as necessary and directed by the Engineer.

- Sedimentation Control System (SCS): SCS shall be placed at the toe of the slope or as directed by the Engineer

- Anti-Tracking Pads: Construction entrances (gravel anti-tracking pads) shall be constructed at truck access/exit points to off-road route. Access road(s) should grade away from the main roadway or waterbody.

- Dust Control: Routine sweeping and application of dust suppression agents, including but not limited to, water and calcium chloride, over exposed subbase shall be completed for dust control. Additional measures may be necessary to minimize dust within the project limits and within staging and stockpile areas.

- Temporary Seeding: On soils to be exposed for a period greater than 1 month but less than 1 year, temporary seeding shall be used to temporarily stabilize the soil until permanent stabilization is be established.

Stabilization practices shall be implemented after completion, as final grades are reached, within seven (7) days.

Temporary seeding shall be spread over any disturbed areas which will remain inactive for at least 30 days. Areas to remain disturbed through winter shall be protected with non-vegetative stabilization measures. The Contractor must provide an Erosion and Sedimentation Control plan for each winter season during construction operations.

The Contractor may use other controls in the project as necessary if they conform to the 2002 Guidelines and are approved by the Engineer. The Contractor will be required to provide the necessary details for any erosion controls not specifically called for on the project plans.

During construction, all areas disturbed by the construction activity that have not been stabilized, structural control measures, and locations where vehicles enter or exit the site shall be inspected at least once a week and within 24 hours of the end of a storm that generates a discharge. For storms that end on a weekend, holiday or other time in which normal working hours will not commence within 24 hours, an inspection is required within 24 hours following any storm in which 0.5 inches or greater of rain occurs. For lesser storms, inspection shall occur immediately upon the start of subsequent normal working hours.

Permanent Stabilization Practices

During construction, the following methods of permanent stabilization shall be installed:

- Topsoiling: In conjunction with permanent seeding, once final grades have been established, topsoil shall be applied to provide a suitable growth medium for vegetation.

- Permanent Seeding: Once soils have been brought to final grade, permanent seeding shall be used to stabilize the soil with a vegetative cover. Disturbed areas below the wetland limit shall be seeded with a wetland seed mix and/or above the wetland limit shall be seeded with a conservation seed mix.

- Landscaping: Wood chip mulch shall be placed around the plants. Plantings (trees, shrubs etc) may be planted along with the permanent seeding.

- Riprap Slopes: To stabilize slopes 2 to 1 or steeper, riprap will be placed on compacted granular fill.

All new embankments disturbed by construction and unpaved areas that are graded or disturbed by construction will receive erosion control matting, topsoil and/or turf establishment. The Contractor may use other permanent stabilization practices approved by the Engineer and conforming to 2002 Guidelines.

Structural Measures

The following structural measures shall be used to divert flows, limit runoff, and minimize the discharge of pollutants:

- Detention Basins (2): The drainage system for a portion of the site includes the basin which is conveying the treated runoff water to the outlet (overflow). The forebay of the basin and the basin are acting as pre-treatment and treatment which will encourage attenuation, infiltration and allow for a reduction in sediment leaving the site

- Minimal Curbing: Curbing shall be avoided wherever possible to maximize overland sheet flow and encourage infiltration.

- Outlet Protection: Riprap outlet protection shall be used at the proposed outlet to decrease velocity and the potential for erosion. (i.e. apron, splash pad…)

Maintenance

All construction activities and related activities shall conform to the requirements of Section 1.10 "Environmental Compliance" of the Department's Standard Specifications, Form 817. In general,

all construction activities shall proceed in such a manner so as not to pollute any wetlands, watercourses, water body, and conduit carrying stormwater. The Contractor shall limit, in so far as possible, the surface area of earthen materials exposed by construction activity and immediately provide temporary and permanent pollution control to prevent soil erosion and contamination on the site. Water pollution control provisions and best management practices per Section 1.10, Environmental Compliance of the Standard Specifications shall be administered during construction. Control measures shall be inspected and maintained in accordance with the 2002 Guidelines and as directed by the Engineer.

4. Dewatering Wastewaters

Dewatering Guidelines

When dewatering is necessary, pumps used shall not be allowed to discharge directly into a wetland, watercourse or stormwater drainage system. Prior to any dewatering, the Contractor must submit to the Engineer a written proposal for specific methods and devices to be used, and must obtain the Engineer's written approval of such methods and devices, including, but not limited to, the pumping of water into a temporary sedimentation basin, providing surge protection at the inlet or outlet of pumps, floating the intake of a pump, or any other method for minimizing and retaining the suspended solids. If the Engineer determines that a pumping operation is causing turbidity problems, the Contractor shall halt said operation until a means of controlling the turbidity is submitted by the Contractor in writing to the Engineer, approved in writing by the Engineer and implemented by the Contractor. No discharge of dewatering wastewater shall contain or cause a visible oil sheen, floating solids or foaming in the receiving water. If required, all activities are to be performed in compliance with the Department's Form 817.

5. Post-Construction Stormwater Management

Post-construction Guidelines

After the project is complete, the Department will perform the following maintenance and restorative measures:

- Litter/debris and sweepings will be removed from the site regularly.
- Mowing and maintenance of the turf areas and vegetated areas will occur as needed.
- Riprap outlet protection will be inspected and repaired annually or as needed.
- The stormwater basin will be inspected and repaired annually or as needed. Sediment will be removed when it interferes with the detention capacity of the basin. Outlets will

be checked for excessive scour and repaired as needed.

- Stormwater drainage system will be cleaned of sediment/debris as directed by the District Drainage Engineer.

Post Construction Performance Standards

Redevelopment:

The project site is an existing repair and maintenance facility and currently has greater than 40% impervious area. The site is currently 65.4% impervious cover and the proposed site would be 70.8% impervious cover. The project was designed to retain on-site the water quality volume for the proposed site. The following values were calculated for the pre and post-construction site conditions:

Pre-Construction Effective Impervious Cover:

$$\text{Effective Impervious Cover} = \frac{\text{Impervious Area of Site (acre)}}{\text{Total Area of Site (acre)}} \times 100\%$$

$$= \frac{5.07 \text{ acres}}{7.75 \text{ acres}} \times 100\%$$

$$= 65.4\%$$

Post-Construction Effective Impervious Cover:

$$\text{Effective Impervious Cover} = \frac{\text{Impervious Area of Site (acre)}}{\text{Total Area of Site (acre)}} \times 100\%$$

$$= \frac{5{,}49 \text{ acres}}{7.75 \text{ acres}} \times 100\%$$

$$= 70.8\%$$

Water Quality Volume (storm water runoff to basin only):

Water quality requirements were satisfied by providing measures designed in accordance with the Connecticut Department of Environmental Protection's 2004 Connecticut Stormwater

Quality Manual. The stormwater basin was designed to act as both a peak flow reducer and a sediment interceptor.

Basin A drains a total of 2.21 acres, of which 1.49 acres is impervious. The required storage volume for the "first flush" is as follows:

WQV = (1") (0.05 + 0.009 I) (A) / 12

WQV = Water Quality Volume, acres ft
R = Volumetric Runoff Coefficient 0.05+.009(I)
I = Percent of Impervious Cover (%)
A = Site Area, acres

WQV = (1") [0.05 + 0.009 x ((1.49/2.21) x 100%)] x 2.21 / 12 = 0.1210 acre-ft

WQV of Basin= 5,269 cf

Forebay-10% of Basin storage= 527 cf

Basin B drains a total of 2.34 acres, of which 2.18 acres is impervious. The required storage volume for the "first flush" is as follows:

WQV = (1") (0.05 + 0.009 I) (A) / 12

WQV = Water Quality Volume, acres ft
R = Volumetric Runoff Coefficient 0.05+.009(I)
I = Percent of Impervious Cover (%)
A = Site Area, acres

WQV = (1") [0.05 + 0.009 x ((2.18/2.34) x 100%)] x 2.34 / 12 = 0.1733 acre-ft

WQV of Basin= 7,547 cf

Forebay-10% of Basin storage= 755 cf

(The pond storage requirements for water quality treatment were more stringent than the requirements for peak flow reduction and therefore were used to design the stormwater pond.)

The impervious area and the weighted runoff coefficient of the site will increase due to the scope of the site re-construction; however, the runoff totals to the adjacent water body (EO #1 and EO#2) will decrease marginally over the current contribution. The reduction in runoff is a result of the proposed design. The new drainage system will direct a large percentage of the site's runoff to be treated by the site's two detention basins. Due to the fact that the new design incorporates two primary treatment methods, the site runoff directed to Culvert Brook was decreased.

Stormwater retention and treatment will be applied to the maximum extent possible. All of the control measures to be installed will be an improvement to existing conditions.

Other Development:

Runoff Reduction and LID Practices:

The stormwater basin, stormwater re-routing, and the elimination of the use of some curbing are strategies to be employed to minimize runoff and incorporate LID methodologies. These techniques will maximize overland sheet flow thereby promoting stormwater infiltration and sediment filtration.

Suspended Solids and Floatables Removal:

The following measures have been employed with the goal of capturing suspended solids and floatables and velocity dissipation:
A goal of 50% to 80% removal of the average annual post-construction total suspended solids load was used in designing primary stormwater management measures (detention basin). .

Velocity Dissipation:

To address stormwater velocity and discharge, a riprap apron will be utilized at the outlet to dissipate velocity and prevent ground erosion. Sizing calculations for the riprap apron can be found in Appendix B.

6. Other Controls

Waste Disposal

Construction site waste shall be properly managed and disposed of during the entire construction period. Additionally,

- A waste collection area will be designated. The selected area will minimize truck travel through the site and will not drain directly to the adjacent wetlands.
- Waste collection shall be scheduled regularly to prevent the containers from overfilling.
- Spills shall be cleaned up immediately.
- Defective containers that may cause leaks or spills will be identified through regular inspection. Any found to be defective will be repaired or replaced immediately.
- Any stockpiling of materials should be confined to the designated area as approved by the engineer.

Washout Areas

Washout of applicators, containers, vehicles and equipment for concrete shall be conducted in a designated washout area. No surface discharge of washout wastewaters from the area will be allowed. All concrete wash water will be directed into a container or pit such that no overflows can occur. Washout shall be conducted in an entirely self-contained system and will be clearly designed and flagged or signed where necessary. The washout area shall be located outside of any buffers and at least 50 feet from any stream, wetland or other sensitive water or natural resources as determined or designated by the Department's Office of Environmental Planning or the project engineer.

Washout Area(s) will be site located by the Contractor, approved by the engineer and the SWPCP revised as appropriate. The "Concrete Washout Area" detail (***See link*** http://www.ct.gov/dot/lib/dot/documents/dpolicy/waternoisecompliance/helpfuldesign/concrete_washout_detail.pdf) shows the recommended method of construction for the washout area. The designated area shall be designed and maintained such that no overflows can occur during rainfall or after snowmelt.

Anti-tracking Pads and Dust Control (Form 817- Sections 2.11/9.39/9.42/9.43)

Off –site vehicle tracking of sediments and the generation of dust shall be minimized. Temporary anti-tracking pads from the active work site to the existing pavement will be installed and maintained at the locations shown on the plans. The Contractor shall:

- Maintain the entrance in a condition which will prevent tracking and washing of sediment onto paved surfaces.
- Provide periodic top dressing with additional stone or additional length as conditions demand.
- Repair any measures used to trap sediment as needed.
- Immediately remove all sediment spilled, dropped, washed or tracked onto paved surfaces.
- Ensure roads adjacent to a construction site are left clean at the end of each day.

If the construction entrance is being properly maintained and the action of a vehicle traveling over the stone pad is not sufficient to remove the majority of the sediment, then the contractor shall either:

- Increase the length of the construction entrance,
- Modify the construction access road surface, or
- Install washing racks and associated settling area or similar devices before the vehicle enters a paved surface.

For construction activities which cause airborne particulates, wet dust suppression shall be utilized. Construction site dust will be controlled by sprinkling the ground surface with water until it is moist on an as-needed basis. The volume of water sprayed shall be such that it suppresses dust yet also prevents the runoff of water.

Post-Construction

Upon completion of construction activities and stabilization of the site, all post-construction stormwater structures, including the catch basins shall be cleaned of construction sediment and any remaining silt fence shall be removed prior to acceptance of the project by CTDOT. Sediment shall be properly disposed of in accordance with all applicable laws, regulations and guidelines.

Maintaining and Storing Vehicles and Equipment

The Contractor shall take measures to prevent any contamination to wetlands and watercourses while maintaining and storing construction equipment on the site. All chemical and petroleum containers stored on site shall be provided with impermeable containment which will hold at least 110% of the volume of the largest container, or 10% of the total volume of all containers in the area, whichever is larger, without overflow from the containment area. All chemicals and their containers shall be stored under a roofed area except for those stored in containers of 100 gallon capacity or more, in which case double-walled tanks will suffice.

7. Inspections

Inspection Guidelines

All construction activities shall be inspected initially within the first 30 days, for Plan implementation and then weekly for Routine Inspections.

The Permittee will maintain a rain gauge on-site to document rainfall amounts. During construction, all areas disturbed by the construction activity that have not been stabilized, all erosion and sedimentation control measures, all structural control measures, soil stockpile areas, washout areas and locations where vehicles enter or exit the site shall be inspected for evidence of, or the potential for, pollutants entering the drainage system and impacts to receiving waters at least once every seven calendar days and within 24 hours of the end of a storm that generates a discharge.

For storms that end on a weekend, holiday or other time in which working hours will not commence within 24 hours, an inspection is required within 24 hours only for storms that equal

or exceed 0.5 inches. For lesser storms, inspection shall occur immediately upon the start of subsequent normal working hours.

Where sites have been temporarily or finally stabilized, such inspection shall be conducted at least once every month for three months. For the final stabilization inspection, once the site has been stabilized for at least three (3) months, such inspection shall be by a qualified inspector to confirm final stabilization and compliance indicated on the Notice of Termination form.

Qualified inspectors provided by the Department's District 3 Office shall conduct inspections.

The following items shall be inspected as described below:

Item	Procedure
Sedimentation Control System (SCS)	The SCS shall be inspected to ensure that the fence line is intact with no breaks or tears. The fence shall be firmly anchored to the ground. Areas where the fence is excessively sagging or where support posts are broken or uprooted shall be noted. Depth of sediment behind the fence shall be noted.
Concrete Washout Area	Containers or pits shall be inspected at least once a week to ensure structural integrity, adequate holding capacity and will be repaired prior to future use if leaks are present. The contractor shall remove hardened concrete waste when it accumulates to a height of ½ of the container or pit or as necessary to avoid overflows. All concrete waste shall be disposed of in a manner consistent will all applicable laws, regulations and guidelines.
Catch Basin Protection	Protective measures shall be inspected to ensure that sediment is not entering the catch basins. Catch basin sumps shall be monitored for sediment deposition. Hay bales shall be inspected to ensure they have not clogged.
Anti-tracking Pad	Locations where vehicles enter or exit the site shall be inspected for evidence of off-site tracking.
Dust Control	Measures shall be taken for the purpose of allaying (diminishing) dust conditions. Measures may include the use of sweeping equipment and/or the application of water or calcium chloride.
General	Construction areas and the perimeter of the site shall be

inspected for any evidence of debris that may blow or wash off site or that has blown or washed off site. Construction areas shall be inspected for any spills or unsafe storage of materials that could pollute off site waters.

8. Keeping Plans Current

Revisions to Stormwater Pollution Control Plans

The Department shall amend the Plan if the actions required by the Plan fail to prevent pollution or otherwise comply with provisions of the General Permit. The Plan shall also be amended whenever there is a change in contractors or sub-contractors at the site. If the results of the inspections require modifications to the Stormwater Pollution Control Plan, the plans shall be revised as soon as practicable after the inspection. Such modifications shall provide for a timely implementation of any changes to non-engineered controls on the site within 24 hours and implementation of any changes to the plan within 3 (three) calendar days following the inspection. For Engineered measures, corrective actions shall be implemented on site within 7 (seven) days and incorporated into a revised Plan within 10 (ten) days of the date of inspection

In no event shall the requirements to keep the Plan current or update a Plan, relieve the permittee and their contactor(s) of the responsibility to properly implement any actions required to protect the waters of the State and to comply with all conditions of the permit.

9. Monitoring Requirements

A written report summarizing the scope of the inspection, the name(s) and qualifications of inspection personnel, the date and time of the inspection, major observations relative to the implementation of the Pollution Control Plan, and actions taken shall be completed within 24 hours of the inspection. This report shall be retained as part of the Stormwater Pollution Control Plan for at least five years after the date of the inspection.

Sampling is required of all point source discharges of Stormwater from disturbed areas. All sampling points should be clearly marked in the field with flags, stakes or other visible markers. Where there are 2 or more discharge points that discharge substantially identical runoff based on similarities of the exposed soils, slope and type of stormwater controls used, up to 5 substantially identical outfalls may be identified for one representative discharge. For linear projects, 10 substantially identical outfalls may be identified for one representative discharge. Additionally, if

the project is planned to continue for more than one year, the inspector as designated by the permittee shall rotate twice per year the location where samples are taken so that a different discharge point is sampled every six months. The outfall locations for sampling will be identified by the inspector, based on disturbance and approved by the engineer and the SWPCP revised as appropriate.

Turbidity monitoring shall be conducted utilizing the drainage plans and a procedure consistent with 40 CFR Part 136 (http://www.epa.gov/region9/qa/pdfs/40cfr136_03.pdf) and may be taken manually or by an in-situ turbidity probe or other automatic sampling device equipped to take individual turbidity readings. The first sample shall be taken within the first hour of stormwater discharge from the site and at least three grab samples shall be taken during a storm event and shall be representative of the flow and characteristics of the discharge. Sampling shall be conducted at least monthly when there is a discharge of stormwater from the site while construction activity is ongoing, until final stabilization of the drainage area associated with each outfall is achieved.

Samples shall be taken during normal working hours, which for this project shall be defined as Monday through Friday, 7 am to 4 pm. If a storm continues past working hours, sampling shall resume the following morning or the morning of the next working day following a weekend or Holiday, as long as the discharge continues. Sampling may be temporarily suspended when conditions exist that may reasonably pose a threat to the safety of the person taking the sample.

Within 30 days following the end of each month, the stormwater sampling results shall be submitted on the Stormwater Monitoring Report (SMR) and submit in accordance with Net DMR. If there is no stormwater discharge during a month, sampling is not required, however, SMR's indicating "no discharge" along with the reason, shall still be submitted as required.

10. Contractors

General

This section shall identify all Contractors and Subcontractors who will perform on site actions which may reasonably be expected to cause or have the potential to cause pollution of the waters of the State.

Certification Statement

All contractors and subcontractors must sign the attached statement. All certification will be included in the Stormwater Pollution Control Plan.

State Project No. 115-121

Putnam Repair Facility and Maintenance Facility
Putnam, CT

"I certify under penalty of law that I have read and understand the terms and conditions of the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities. I understand that as Contractor on the project, I am covered by this General Permit, and must comply with the terms and conditions of this permit, including, but not limited to, the requirements of the Stormwater Pollution Control Plan prepared for this project."

GENERAL CONTRACTOR

Signed:_____ Date:_____

Title:_____

Firm:_____ Telephone:_____

Address:_____

_____

_____

SUBCONTRACTOR

Signed:_____ Date:_____

Title:_____

Firm:_____ Telephone:_____

Address:_____

_____

_____

General:

This Stormwater Pollution Control Plan (SPCP) is prepared to comply with the requirements for the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities. Also to be considered part of the SPCP are the proposed construction plans, special provisions, and the Connecticut Department of Transportation's "Standard Specifications for Roads, Bridges and Incidental Construction" (Form 817) including supplements thereto and the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control and 2004 Stormwater Quality Manual.

List of applicable Figures / Plans:

List of Applicable Figures and Forms:

Appendix A – Figures

USGS Topographical Map and Site Location	Figure 1
NDDB Determination Letter and Resource Map	Figure 1B
Soil Survey Map	Figure 1C
Aerial Photo	Figure 2
Pre-Constructions AI Conditions/ Runoff Coefficients	Figure 3
Post-Constructions AI Conditions/ Runoff Coefficients	Figure 4
Disturbed/Erodible Areas	Figure 5

Appendix B – Drainage Calculations

Pre-Construction Drainage Areas	Figure 6
Existing Drainage Calculations	Figure 7
Post Construction Drainage Areas	Figure 8
Proposed Drainage Calculations	Figure 9
Water Quality Volume Computations and Outlet Protection Design	Figure 10
Detention Basin Areas	Figure 11
Detention Basin Routing- 10 year	Figure 12

Appendix C – Plan Sheets

Existing Conditions & Boring Locations	SD-002
Phasing Plans	SD-003-005
Boring Logs (15)	SD-006-020
Site Plan	C-005
Drainage Plan	C-006
Pavement Plan	C-008
Grading Plan	C-009
Miscellaneous Details (2)	C-012, C-017
Environmental	ENV-02-03

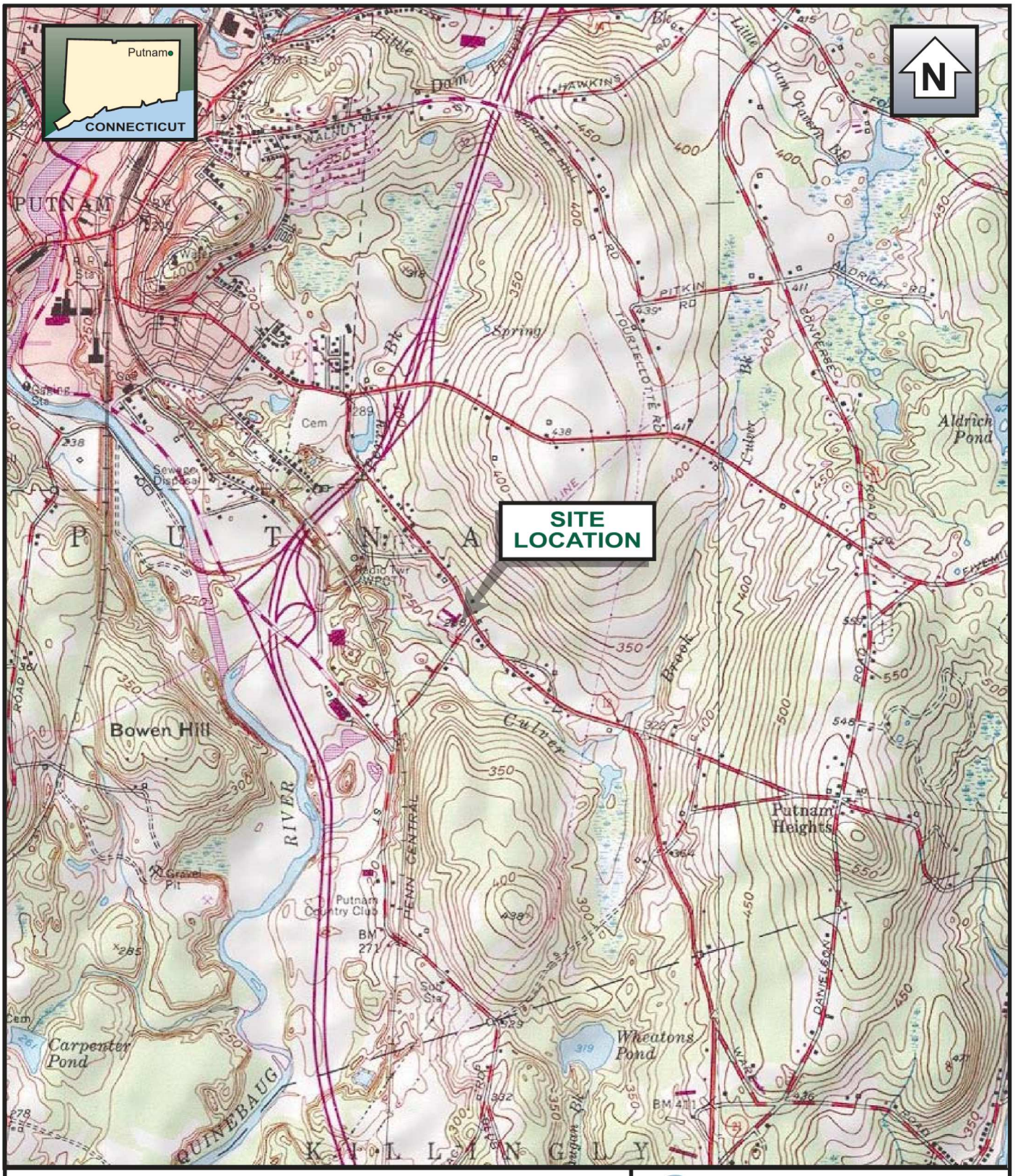
Appendix D – Stormwater Monitoring Report Form

Appendix E – Notice of Termination Form

APPENDIX A

Figures

State Project No. 0115-0121



0 2000
SCALE FEET

0 1
SCALE MILE

1:24000

BASE CREATED WITH TOPO™ © 1996 WILDFLOWERS PRODUCTIONS,
www.topo.com - 7.5' USGS TOPOGRAPHIC MAPS

TRC
21 Griffin Rd. North
Windsor, CT 06095
(860) 298-9692

CONNDOT TASK 210 SUBSURFACE SITE INVESTIGATION
PUTNAM MAINTENANCE AND REPAIR FACILITY
3 INDUSTRIAL PARK ROAD, PUTNAM, CONNECTICUT

SITE LOCATION MAP

Date: 11/2017 | **Project No.** 237612.5429.000210

FIGURE 1

Connecticut Department of

ENERGY &
ENVIRONMENTAL
PROTECTION

October 25, 2019

Mr. Aaron Ferraro
CT Department of Transportation
2800 Berlin Turnpike
P.O. Box 317546
Newington, CT 06111-4113
Aaron.ferraro@ct.gov

Project: CTDOT 115-121, Putnam Maintenance Facility Rehabilitation and Addition Located at 3 Industrial Park Road in Putnam, Connecticut
NDDB Determination No.: 201912142 (Formerly NDDB # 201704893)

Dear Aaron,

I have re-reviewed Natural Diversity Data Base maps and files regarding the area delineated on the map provided for CTDOT 115-121, Putnam Maintenance Facility rehabilitation and addition at 3 Industrial Park Road in Putnam, Connecticut. As you are aware, according to our information, there are records for State Special Concern banded sunfish (*Enneacanthus obesus*) in the vicinity of this project. Thank you for providing the following best management practices you will use to protect this fish species from project impacts. The best management practices include:

- Limiting work to within the existing footprint to within the developed site.
- Employing erosion and sedimentation control best practices.
- Prohibiting in water work or work within wetlands.
- Stabilizing disturbed areas during construction.
- And ensure that there will not be a significant increase in run-off from the site post-rehabilitation.

Please be advised that a DEEP Fisheries Biologist will review the permit applications you may submit to DEEP regulatory programs to determine if your project could adversely affect banded sunfish. DEEP Fisheries Biologists are routinely involved in pre-application consultations with regulatory staff and applicants in order to identify potential fisheries issues and work with applicants to mitigate negative effects, including to endangered species. If you have not already talked with a Fisheries Biologist about your project, you may contact the Permit Analyst assigned to process your application for further information, including the contact information for the Fisheries Biologist assigned to review your application. Please re-submit an NDDB Request for Review if the scope of work changes or if work has not begun on this project by October 25, 2021.

Natural Diversity Data Base information includes all information regarding critical biological resources available to us at the time of the request. This information is a compilation of data collected over the years by the Department of Energy and Environmental Protection's Natural History Survey and cooperating units of DEEP, private conservation groups and the scientific community. This information is not necessarily the result of comprehensive or site-specific field investigations. Consultations with the Data Base should not be substitutes for on-site surveys required for environmental assessments. Current research projects and new contributors continue to identify additional populations of species and locations of habitats of concern, as well as, enhance existing data. Such new information is incorporated into the Data Base as it becomes available. The result of this review does not preclude the possibility that listed species may be encountered on site and that additional action may be necessary to remain in compliance with certain state permits.

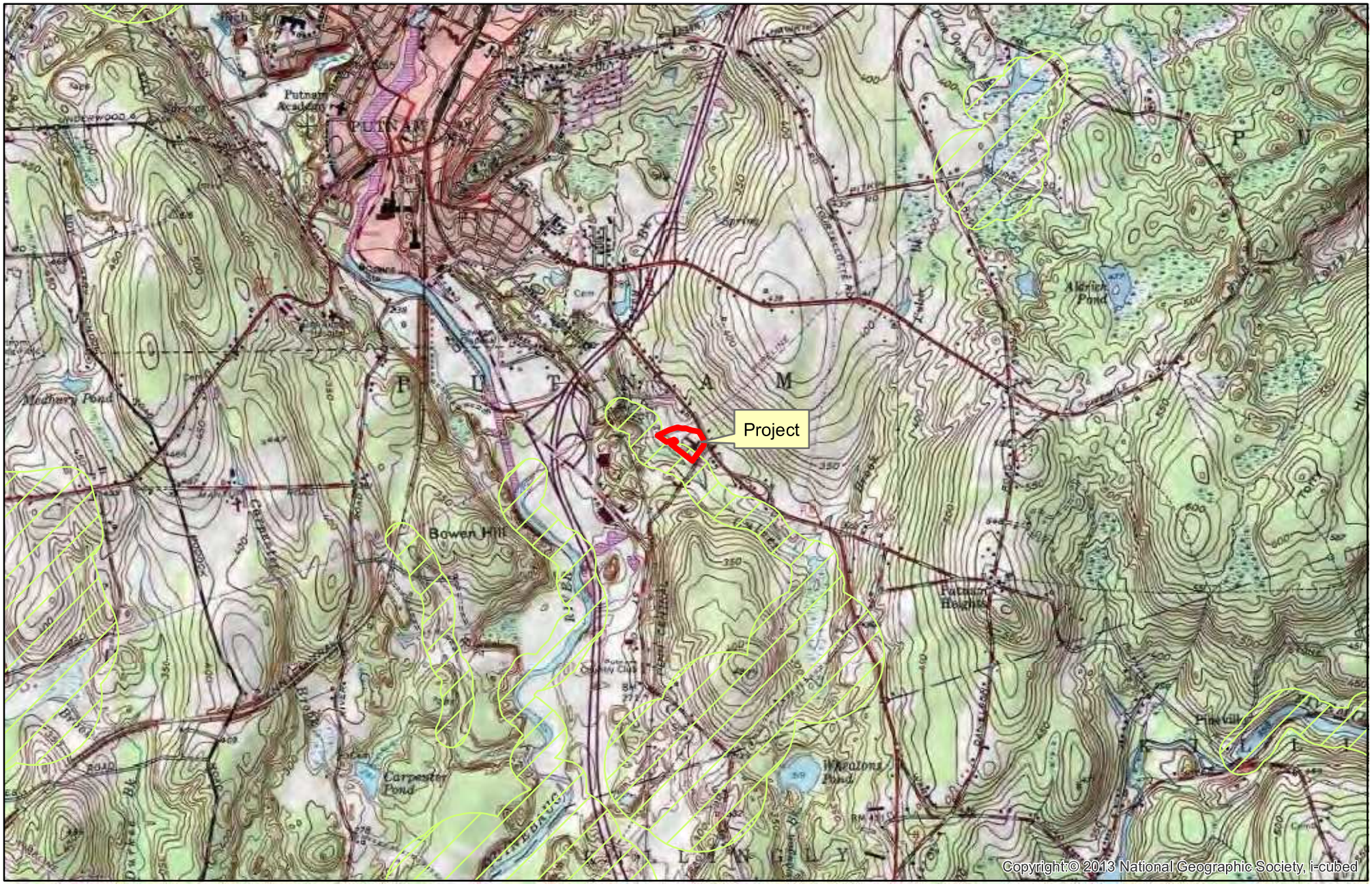
Please contact me if you have further questions at (860) 424-3592, or dawn.mckay@ct.gov . Thank you for consulting the Natural Diversity Data Base.

Sincerely,

Dawn M. McKay

Dawn M. McKay
Environmental Analyst 3

FIGURE 1B



Map data maintained by the Connecticut Departments of Environmental Protection and Public Health. Map printed by the Connecticut Department of Transportation for internal use only. NDDB Data v. Dec 2018

Attachment A: Overview Map - Project 115-121 Putnam, CT
Putnam Maintenance Facility Renovation

Requester: State of Connecticut, Department of Transportation
10/03/2019

N
W E
S

Quadrangle: 28 - Putnam

2,000 1,000 0 2,000 Feet

Connecticut Department of Transportation
2800 Berlin Tpk., Newington, CT 06131

FIGURE 1B

Map data maintained by the Connecticut Departments of Environmental Protection and Public Health. Map printed by the Connecticut Department of Transportation for internal use only. NDDB Data v. Dec 2018

Attachment B: Detailed Site Map- Project 115-121 Putnam, CT
Putnam Maintenance Facility Renovation

Requester: State of Connecticut, Department of Transportation
10/03/2019

N
W E
S

Quadrangle: 28 - Putnam

500 250 0 500 Feet

Connecticut Department of Transportation
2800 Berlin Tpk., Newington, CT 06131

FIGURE 1B

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

State of Connecticut

Putnam

April 13, 2020

FIGURE 1C

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

FIGURE 1C

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

FIGURE 1C

Contents

FIGURE 1C

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

FIGURE 1C

Custom Soil Resource Report
Soil Map

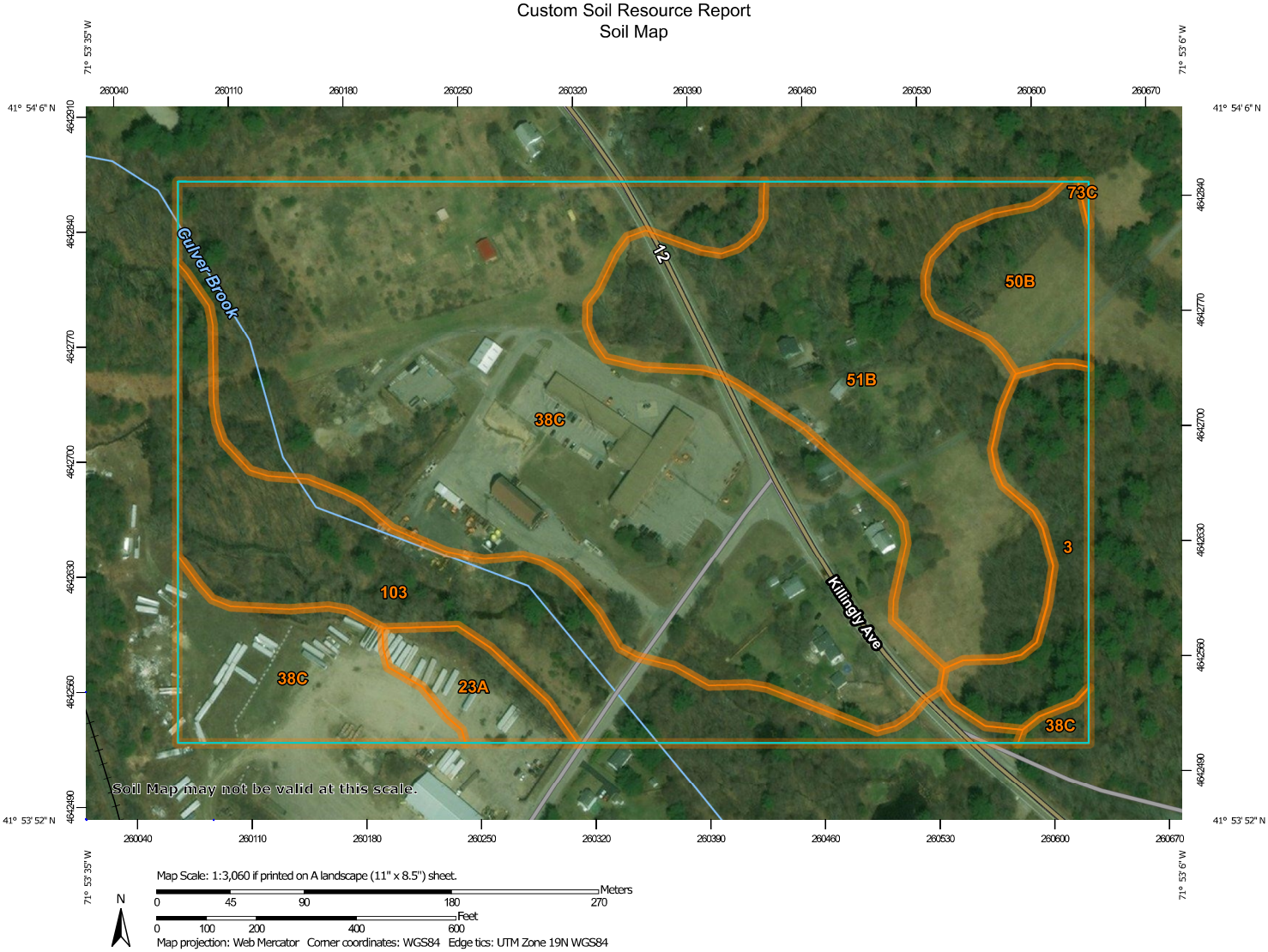


FIGURE 1C

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: State of Connecticut
Survey Area Data: Version 19, Sep 13, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 14, 2011—Aug 27, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

FIGURE 1C

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
3	Ridgebury, Leicester, and Whitman soils, 0 to 8 percent slopes, extremely stony	2.5	5.3%
23A	Sudbury sandy loam, 0 to 5 percent slopes	1.2	2.5%
38C	Hinckley loamy sand, 3 to 15 percent slopes	24.5	52.0%
50B	Sutton fine sandy loam, 3 to 8 percent slopes	2.0	4.3%
51B	Sutton fine sandy loam, 0 to 8 percent slopes, very stony	9.9	21.0%
73C	Charlton-Chatfield complex, 0 to 15 percent slopes, very rocky	0.0	0.0%
103	Rippowam fine sandy loam	7.0	14.9%
Totals for Area of Interest		**47.1**	**100.0%**

FIGURE 1C

FIGURE 2
PROJECT NO. 115-121

PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

AERIAL PHOTO

ZONE:	AREA:	AI:
GRASS/TURF	2.68 ACRES	1.02
CONCRETE/PAVEMENT	4.38 ACRES	3.95
ROOF	0.69 ACRES	0.69

EXISTING TOTAL AI# 5.66

RUNNOFF COEFFICIENT:

$$\text{ESTIMATED RUNNOFF COEFFICIENT} = \frac{\text{PROPOSED AI\#}}{\text{AREA (ACRES)}} = \frac{(0.25 \text{ ACRES} \times 0.2)+(0.14 \text{ ACRES} \times 0.3)+(2.29 \text{ ACRES} \times 0.4)+(4.38 \text{ ACRES} \times 0.9)+(0.69 \text{ ACRES} \times 1.0)}{7.75 \text{ ACRES}} = \boxed{0.73}$$

FIGURE 3

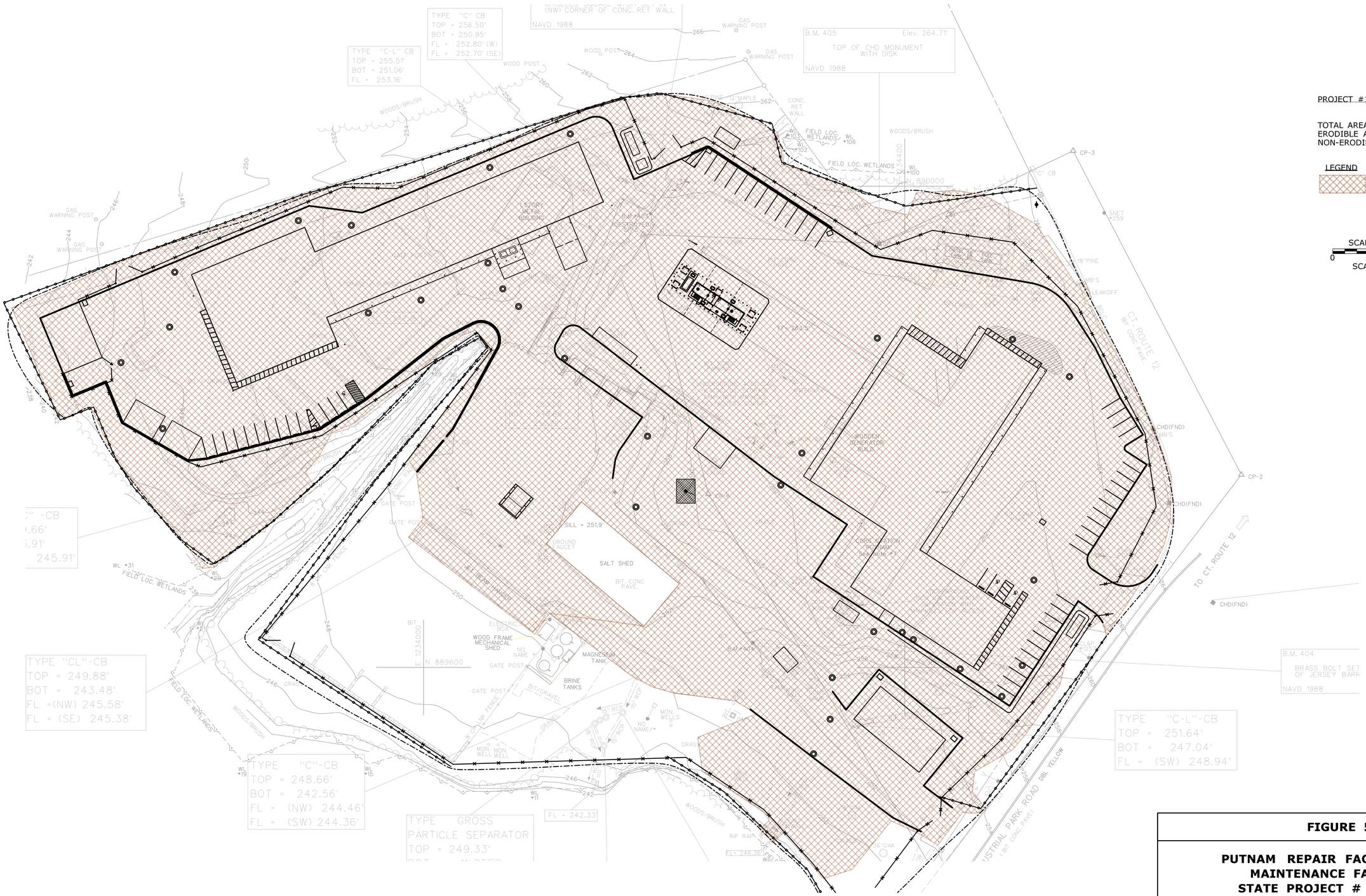
PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY
STATE PROJECT #115-121
PRE-CONSTRUCTION AI CONDITION/ RUNOFF COEFFICIENT
DATE: MAY 2020

RUNNOFF COEFFICIENT:

$$\text{ESTIMATED RUNNOFF COEFFICIENT} = \frac{\text{PROPOSED AI\#}}{\text{AREA (ACRES)}} = \frac{(1.19 \text{ ACRES} \times 0.3)+(0.17 \text{ ACRES} \times 0.4)+(4.21 \text{ ACRES} \times 0.9)+(1.28 \text{ ACRES} \times 1.0)+(0.9 \text{ ACRES} \times 0.45)}{7.75 \text{ ACRES}} = \boxed{0.76}$$

FIGURE 4

PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY
STATE PROJECT #115-121
POST-CONSTRUCTION AI CONDITIONS/ RUNOFF COEFFICIENT
DATE: MAY 2020



PROJECT #115-121

TOTAL AREA	7.65 ACRES
ERODIBLE AREA	7.54 ACRES
NON-ERODIBLE AREA	0.11 ACRES

LEGEND

ERODIBLE SOIL

SCALE IN FEET

0 40 80

SCALE 1"=40'

COORDINATE GRID

N AD 83

CONNECTICUT

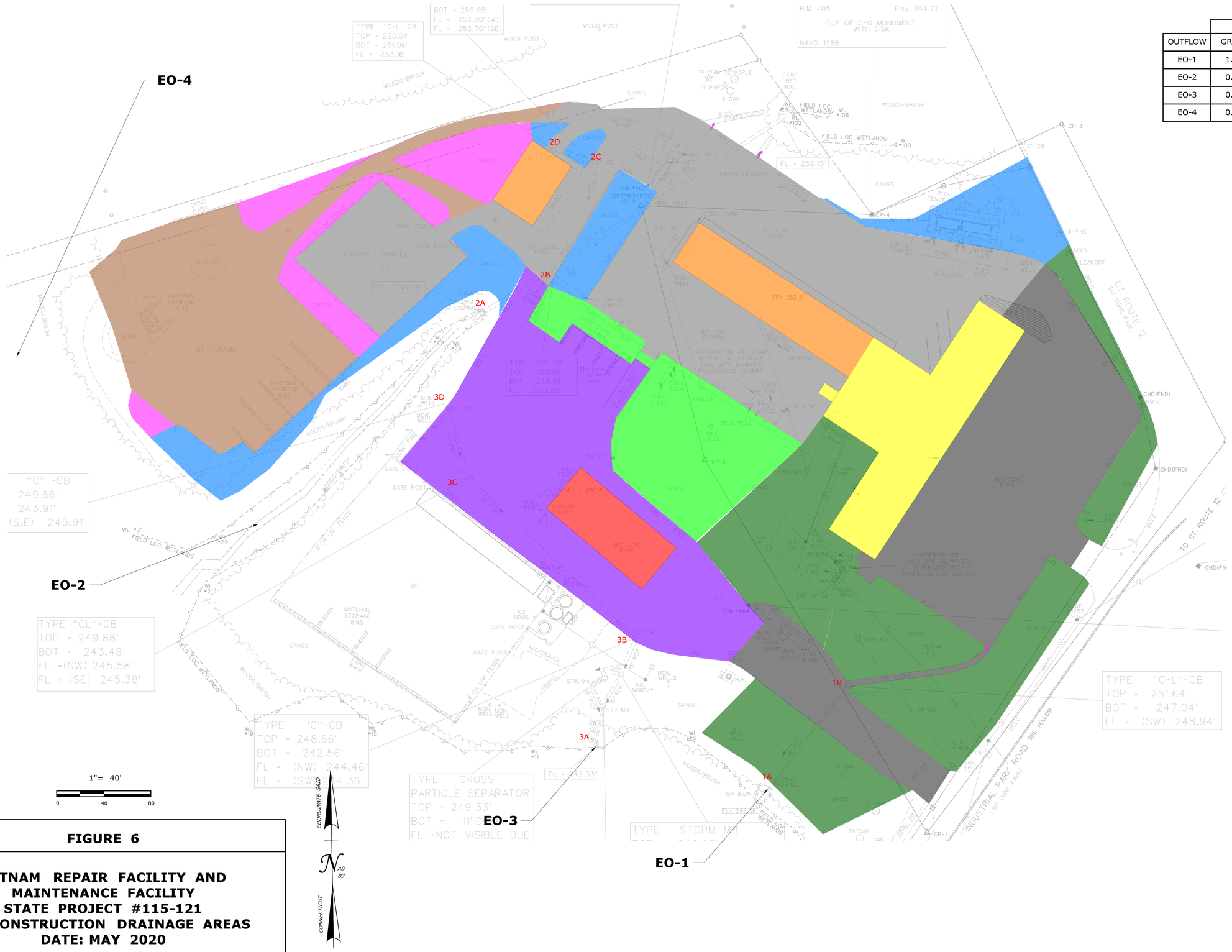
FIGURE 5

PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY
STATE PROJECT # 115-121
DISTURBED/ERODIBLE AREAS
DATE MAY 2020

APPENDIX B

Drainage Calculations

State Project No. 0115-0121



OUTFLOW	AREAS (ACRES) GRASS	PAVEMENT	ROOF	TOTAL
EO-1	1.11	1.03	0.36	2.50
EO-2	0.48	1.45	0.22	2.15
EO-3	0.39	0.84	0.11	1.34
EO-4	0.27	0.77	0.00	1.04

FLOW TO EO-1:
DRAINAGE SYSTEM 1:
- ROOF AREA
- CONCRETE/PAVEMENT AREA
- GRASS/TURF AREA

FLOW TO EO-2:
DRAINAGE SYSTEM 2:
- ROOF AREA
- CONCRETE/PAVEMENT AREA
- GRASS/TURF AREA

FLOW TO EO-3:
DRAINAGE SYSTEM 3:
- ROOF AREA
- CONCRETE/PAVEMENT AREA
- GRASS/TURF AREA

FLOW TO EO-4:
SHEET FLOW:
- CONCRETE/PAVEMENT AREA
- GRASS/TURF AREA

FIGURE 6

PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY
STATE PROJECT #115-121
PRE-CONSTRUCTION DRAINAGE AREAS
DATE: MAY 2020

Project No. 115-121
Town: Putnam

Computed By: Kyle Pelletier
Checked By: Matt Easdon

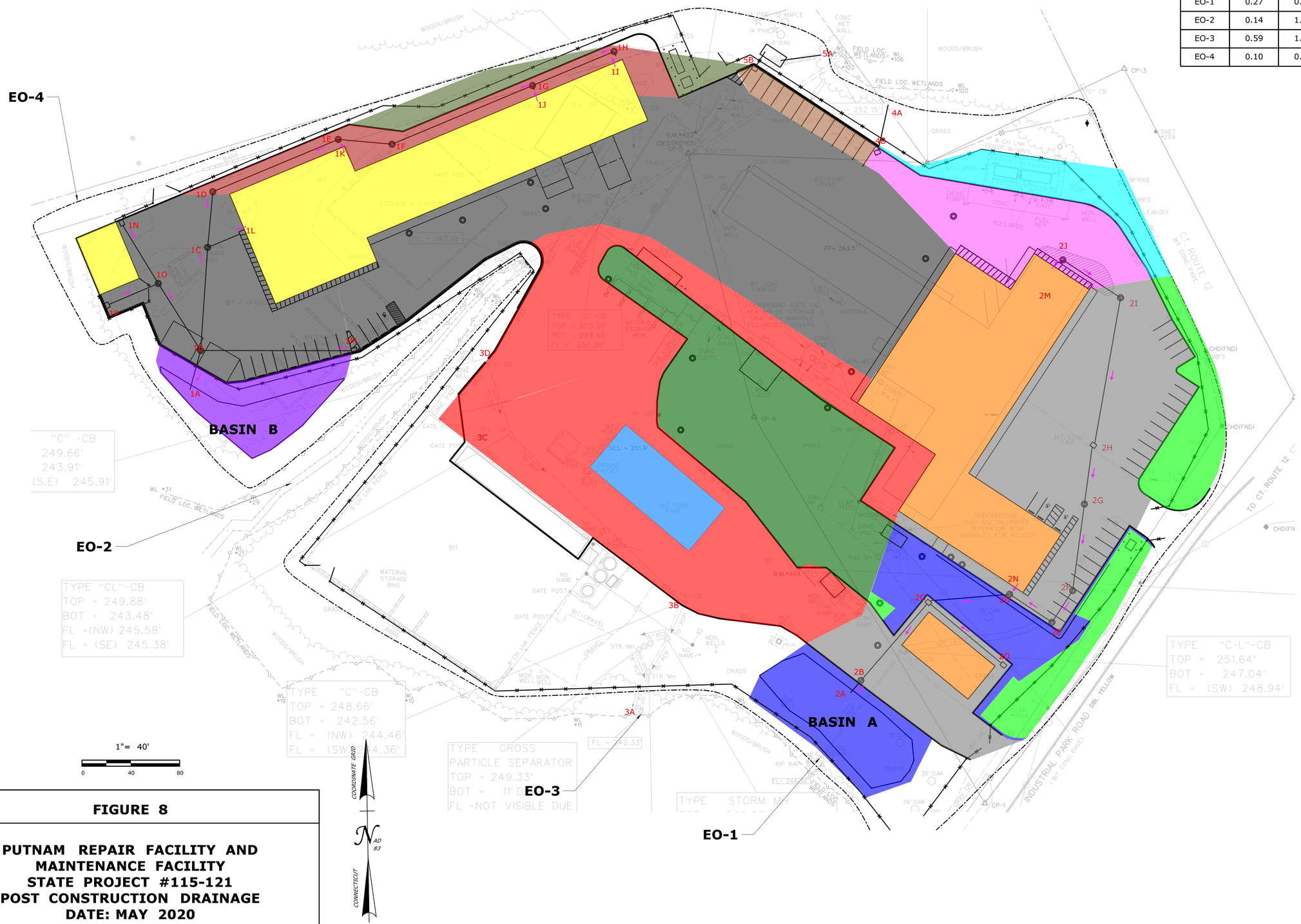
Date:May 2020

Existing Storm Drainage System (100 year storm)

Station / Structure		A Drainage Area (acres)		C - Runoff Coefficient	AC		T_c Flow Time (min)			I - Rainfall Intensity	Q in System (cfs)	Pipe			Q_F - Full Capacity (cfs)	Velocity (fps)		Invert Elevations (ft)		Headwater	"n"
From	To	Increment	Total		Increment	Total	To Inlet	In Pipe	Accumulated			Size (in.)	Length (ft.)	Slope (ft/ft)		V_F Flowing Full	V Design Flow	Upper End	Lower End		
1B	1A	1.073	1.073	0.740	0.794	0.794	5.00	0.22	5.22	7.80	6.19	18	110	0.023	17.31	9.1	8.2	248.94	246.36	0.8	0.013
2D	2C	0.092	0.092	0.889	0.082	0.082	5.00	0.14	5.14	7.80	0.64	12	30	0.012	4.20	5.0	3.5	253.16	252.80	0.5	0.013
2C	2A	0.067	0.159	0.743	0.050	0.132	5.14	0.54	5.68	7.76	1.02	15	175	0.032	12.34	9.4	5.4	252.70	247.18	0.6	0.013
2B	2A	0.845	0.845	0.843	0.713	0.713	5.00	0.11	5.11	7.80	5.56	15	66	0.047	15.01	11.4	10.4	250.26	247.18	0.6	0.013
3D	3C	0.376	0.376	0.782	0.294	0.294	5.00	0.25	5.25	7.80	2.29	15	58	0.006	5.24	4.0	3.9	245.91	245.58	0.6	0.013
3C	3B	0.552	0.928	0.488	0.269	0.564	5.25	0.77	6.02	7.73	4.36	15	193	0.005	4.80	3.6	4.2	245.38	244.46	0.6	0.013
3B	3A	0.416	1.344	0.927	0.386	0.949	6.02	0.19	6.21	7.49	7.11	15	96	0.021	10.10	7.7	8.4	244.36	242.33	0.6	0.013

FIGURE 7

	AREAS (ACRES)				
OUTFLOW	GRASS	PAVEMENT	ROOF	STONE	TOTAL
EO-1	0.27	0.84	0.62	0.40	2.13
EO-2	0.14	1.95	0.56	0.16	2.81
EO-3	0.59	1.12	0.11	0.00	1.82
EO-4	0.10	0.17	0.00	0.00	0.27



FLOW TO EO-1:
DRAINAGE SYSTEM 2:
- IMPERVIOUS AREA
- CONCRETE/PAVEMENT AREA
- PERVIOUS AREA
- STONE AREA

FLOW TO EO-2:
DRAINAGE SYSTEM 1:
- IMPERVIOUS AREA
- CONCRETE/PAVEMENT AREA
- STONE AREA

DRAINAGE SYSTEM 4:
- CONCRETE/PAVEMENT AREA
- PERVIOUS AREA

DRAINAGE SYSTEM 5:
- CONCRETE/PAVEMENT AREA

FLOW TO EO-3:
DRAINAGE SYSTEM 3:
- IMPERVIOUS AREA
- CONCRETE/PAVEMENT AREA
- PERVIOUS AREA

FLOW TO EO-4:
SHEET FLOW:
- CONCRETE/PAVEMENT
- CONCRETE/PAVEMENT

FIGURE 8

PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY
STATE PROJECT #115-121
POST CONSTRUCTION DRAINAGE
DATE: MAY 2020

Project No. 115-121
Town: Putnam

Computed By: Kyle Pelletier
Checked By: Matt Easdon

Date:May 2020

Proposed Storm Drainage System (100 year storm)

Station / Structure		A Drainage Area (acres)		C - Runoff Coefficient	AC		T_c Flow Time (min)			I - Rainfall Intensity	Q in System (cfs)	Pipe			Q_F - Full Capacity (cfs)	Velocity (fps)		Invert Elevations (ft)		Headwater	"n"
From	To	Increment	Total		Increment	Total	To Inlet	In Pipe	Accumulated			Size (in.)	Length (ft.)	Slope (ft/ft)		V_F Flowing Full	V Design Flow	Upper End	Lower End		
1I	1H	0.039	0.039	1.000	0.039	0.039	5.00	0.05	5.05	7.80	0.31	6	10	0.010	0.78	3.7	3.4	252.15	252.05	0.3	0.010
1H	1G	0.000	0.039	#DIV/0!	#DIV/0!	0.039	5.05	0.59	5.64	7.79	0.31	12	72	0.005	2.78	3.3	2.0	252.05	251.67	0.5	0.013
1J	1G	0.158	0.158	1.000	0.158	0.158	5.00	0.04	5.04	7.80	1.23	6	10	0.010	0.78	3.7	4.3	251.77	251.67	0.3	0.010
1G	1F	0.000	0.197	#DIV/0!	#DIV/0!	0.197	5.53	0.62	6.15	7.64	1.51	12	125	0.005	2.74	3.3	3.3	251.67	251.03	0.5	0.013
1F	1E	0.000	0.197	#DIV/0!	#DIV/0!	0.197	6.03	0.18	6.21	7.49	1.48	12	44	0.010	3.83	4.6	4.2	251.03	250.59	0.5	0.013
1K	1E	0.138	0.138	1.000	0.138	0.138	5.00	0.04	5.04	7.80	1.08	6	10	0.010	0.78	3.7	4.3	259.69	259.59	0.3	0.010
1E	1D	0.000	0.335	#DIV/0!	#DIV/0!	0.335	6.21	0.38	6.59	7.44	2.50	12	111	0.010	3.83	4.6	4.9	250.59	249.48	0.5	0.013
1D	1C	0.000	0.335	#DIV/0!	#DIV/0!	0.335	6.59	0.15	6.74	7.32	2.46	12	45	0.010	3.83	4.6	4.8	249.48	249.03	0.5	0.013
1L	1C	0.181	0.181	1.000	0.181	0.181	5.00	0.15	5.15	7.80	1.41	6	38	0.010	0.78	3.7	4.3	249.41	249.03	0.3	0.010
1C	1B	0.000	0.516	#DIV/0!	#DIV/0!	0.516	6.72	0.26	6.98	7.28	3.76	12	83	0.010	3.83	4.6	5.3	249.03	248.20	0.5	0.013
1N	1O	0.132	0.132	0.900	0.119	0.119	5.00	0.25	5.25	7.80	0.93	12	56	0.010	3.83	4.6	3.8	247.43	246.87	0.5	0.013
1P	1O	0.216	0.216	0.919	0.199	0.199	5.00	0.22	5.22	7.80	1.55	12	44	0.005	2.71	3.2	3.3	247.09	246.87	0.5	0.013
1O	1B	0.000	0.348	#DIV/0!	#DIV/0!	0.317	5.25	0.28	5.53	7.73	2.45	12	62	0.005	2.71	3.2	3.7	246.87	246.56	0.5	0.013
1M	1B	1.168	2.032	0.900	1.051	1.884	5.00	0.36	5.36	7.80	14.70	24	125	0.005	17.21	5.1	5.8	247.13	246.50	1.0	0.013
1B	1A	0.000	2.032	#DIV/0!	#DIV/0!	1.884	6.98	0.10	7.08	7.21	13.59	24	33	0.005	17.21	5.1	5.7	246.17	246.00	1.0	0.013
2M	2J	0.407	0.407	1.000	0.407	0.407	5.00	0.04	5.04	7.80	3.18	6	10	0.010	0.78	3.7	4.3	0.10	0.00	0.3	0.010
2J	2I	0.000	0.407	#DIV/0!	#DIV/0!	0.407	5.04	0.20	5.24	7.79	3.17	12	61	0.010	3.83	4.6	5.1	257.74	257.13	0.5	0.013
2I	2H	0.000	0.407	#DIV/0!	#DIV/0!	0.407	5.24	0.39	5.63	7.73	3.15	12	121	0.010	3.83	4.6	5.1	257.13	255.92	0.5	0.013
2H	2G	0.581	0.988	0.790	0.459	0.867	5.63	0.13	5.76	7.61	6.60	15	46	0.010	6.95	5.3	6.1	255.92	255.46	0.6	0.013
2G	2F	0.000	0.988	#DIV/0!	#DIV/0!	0.867	5.75	0.19	5.94	7.58	6.57	15	71	0.010	6.95	5.3	6.1	255.46	254.75	0.6	0.013
2F	2E	0.000	0.988	#DIV/0!	#DIV/0!	0.867	5.94	0.08	6.02	7.52	6.52	15	30	0.010	6.95	5.3	6.1	254.75	254.45	0.6	0.013
2E	2D	0.000	0.988	#DIV/0!	#DIV/0!	0.867	6.02	0.12	6.14	7.49	6.49	15	45	0.010	6.95	5.3	6.1	254.45	254.00	0.6	0.013
2N	2D	0.159	0.159	1.000	0.159	0.159	5.00	0.04	5.04	7.80	1.24	6	10	0.010	0.78	3.7	4.3	254.10	254.00	0.3	0.010
2D	2C	0.000	1.148	#DIV/0!	#DIV/0!	1.026	6.14	0.18	6.32	7.46	7.65	18	61	0.007	9.45	5.0	5.6	249.41	248.98	0.8	0.013
2O	2C	0.112	0.112	0.593	0.066	0.066	5.00	0.52	5.52	7.80	0.52	12	75	0.005	2.73	3.2	2.4	249.61	249.23	0.5	0.013
2C	2B	0.133	1.393	0.541	0.072	1.164	6.32	0.24	6.56	7.40	8.62	18	82	0.007	9.45	5.0	5.8	248.98	248.41	0.8	0.013
2B	2A	0.000	1.393	#DIV/0!	#DIV/0!	1.164	6.56	0.03	6.59	7.33	8.53	18	12	0.007	9.45	5.0	5.7	248.41	248.33	0.8	0.013
3D	3C	0.514	0.514	0.800	0.411	0.411	5.00	0.23	5.23	7.80	3.21	15	58	0.006	5.24	4.0	4.2	245.91	245.58	0.6	0.013
3C	3B	0.375	0.889	0.574	0.215	0.627	5.23	0.76	5.99	7.73	4.84	15	193	0.005	4.80	3.6	4.3	245.38	244.46	0.6	0.013
3B	3A	0.748	1.637	0.594	0.444	1.071	5.99	0.19	6.18	7.50	8.03	15	96	0.021	10.10	7.7	8.6	244.36	242.33	0.6	0.013
4B	4A	0.456	0.456	0.610	0.278	0.278	5.00	0.10	5.10	7.80	2.17	12	38	0.026	6.22	7.4	6.6	258.00	257.00	0.5	0.013
5B	5A	0.055	0.055	0.900	0.050	0.050	5.00	0.24	5.24	7.80	0.39	6	60	0.023	0.92	4.4	4.2	255.50	254.10	0.3	0.013

FIGURE 9

Figure 10: Water Quality Computations and Outlet Protection Design- Putnam Repair Facility and Maintenance Facility

Water Quality Computations:

Water quality requirements were satisfied by providing measures designed in accordance with the Connecticut Department of Environmental Protection's 2004 Connecticut Stormwater Quality Manual. The stormwater basin was designed to act as a sediment interceptor.

Basin A

The basin drains a total of 2.21 acres, of which 1.49 acres is impervious. The required storage volume for the "first flush" is as follows:

WQV = (1") (.05 + .009 I) (A)/12

WQV = Water Quality Volume, acres ft

R = Volumetric Runoff Coefficiennt 0.05 + 0.009 I

I = Percent of Impervious Cover (%)

A = Site Area, Acres

WQV = (1") [0.05 + 0.009 x ((1.49/2.21) x 100%)] x 2.21 / 12 = 0.121 acre ft

WQV of Basin = 5,270 cf

Forebay- 10% of Basin Storage = 527 cf

Basin B

The basin drains a total of 2.34 acres, of which 2.18 acres is impervious. The required storage volume for the "first flush" is as follows:

WQV = (1") (.05 + .009 I) (A)/12

WQV = Water Quality Volume, acres ft

R = Volumetric Runoff Coefficiennt 0.05 + 0.009 I

I = Percent of Impervious Cover (%)

A = Site Area, Acres

WQV = (1") [0.05 + 0.009 x ((2.18/2.34) x 100%)] x 2.34 / 12 = 0.173 acre ft

WQV of Basin = 7,550 cf

Forebay- 10% of Basin Storage = 755 cf

<u>Riprap Outlet Protection Design-</u>

<u>Basin A:</u>

Median stone diameter for velocity of 0 to 8 fps = Modified (5")

Riprap outlet protection at reinforced concrete culvert end (H)

d = 0.42 ft

Do = 1.5 ft

Q = 8.53 cfs

L_{apron} = (1.7 Q/ Do 3/2) + 8 Do

L_{apron} = (1.7 * 8.53/ 1.5 * 3/2) + 8 * 1.5

L_{apron} = 19.9 ft

W_{apron} = 3Do + La

W_{apron} = 3 * 1.5 + 19.9

W_{apron} = 24.4 ft

Riprap Pad:

Depth = 1 ft

Length = 19.9 ft

Wdith = 24.4 ft

<u>Basin B:</u>

Median stone diameter for velocity of 0 to 8 fps = Modified (5")

Riprap outlet protection at reinforced concrete culvert end (H)

FIGURE 10

d = 0.42 ft

Do = 1.5 ft

Q = 13.59 cfs

L_{apron} = (1.7 Q/ Do 3/2) + 8 Do

L_{apron} = (1.7 * 13.59/ 1.5 * 3/2) + 8 * 1.5

L_{apron} = 24.6 ft

W_{apron} = 3Do + La

W_{apron} = 3 * 1.5 + 24.6

W_{apron} = 29.1 ft

Riprap Pad:

Depth = 1 ft

Length = 24.6 ft

Wdith = 29.1 ft

The area of the riprap outlet protection at both basin culvert ends meet the criteria in the CT DOT Drainage Manual.

FIGURE 10

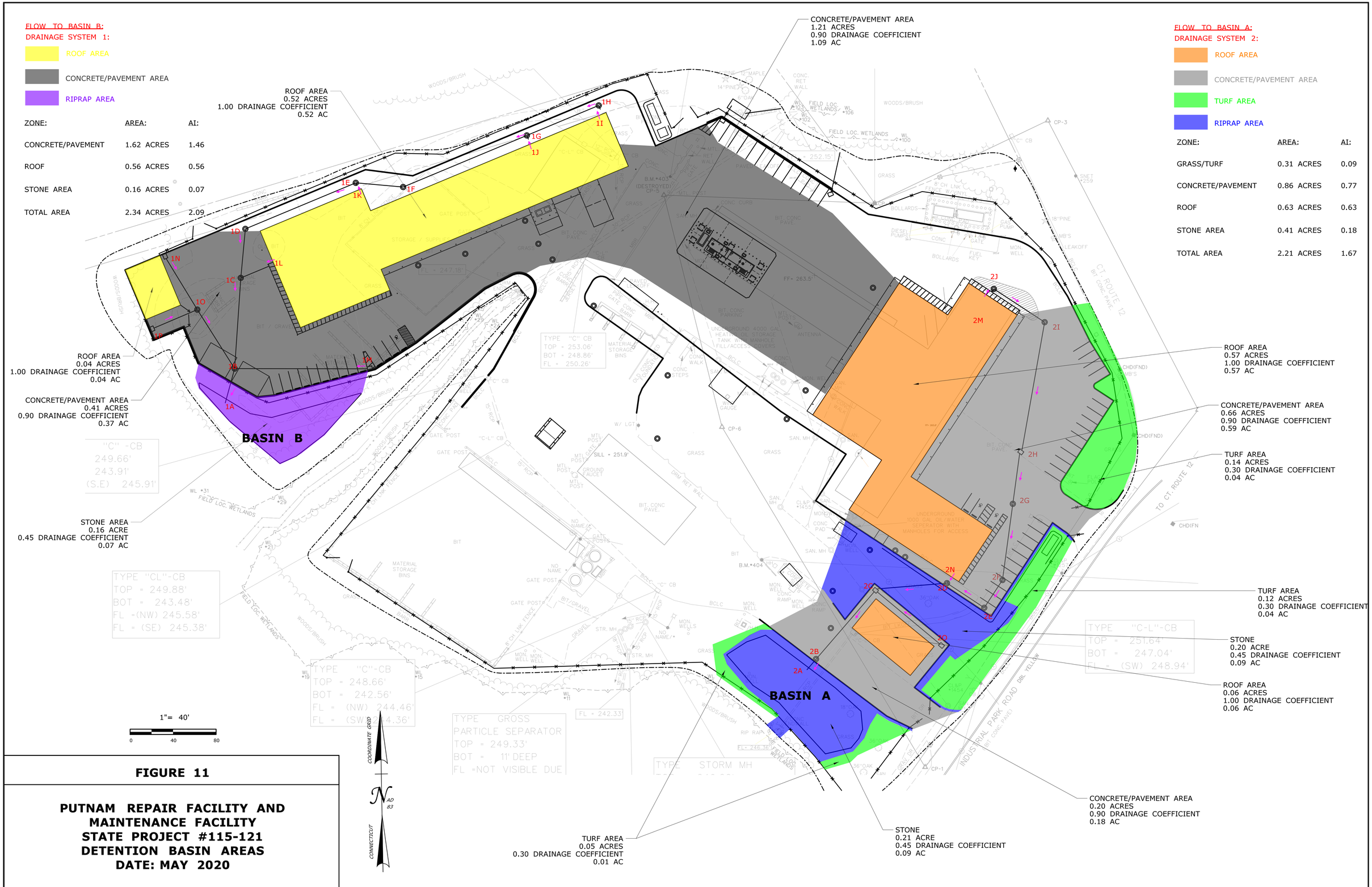


FIGURE 11

PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY
STATE PROJECT #115-121
DETENTION BASIN AREAS
DATE: MAY 2020

Detention Basin A- Putnam design

Project 115-121

* Calculations based on CT Stormwater Quality Manual 10 yr storm.

	Basin	elevation	area in sf at elev.	CF per increment	Total Vol.- cf
Forebay	0	246.0	53		
	0.5	246.5	170	56	56
	1	247.0	340	128	183
	1.5	247.5	561	225	409
Basin	0	246.0	2363		
	0.5	246.5	2856	1305	1305
	1	247.0	3362	1555	2859
	1.5	247.5	3875	1809	4669
	2	248.0	5055	2233	6901
	2.5	248.5	5541	2649	9550
	3	249.0	6066	2902	12452
	3.5	249.5	6710	3194	15646

Inlet pipe: 18" RCP @ inv. 248.25

Outlet swale: Turf Channel, inv. @ elev. 247.0, S= .01

Total AI in(pavement + grass): 1.68

Dpth of Basin: 2.5 ft

Turf Channel: 3 ft

lgt of channel 7 ft

T(min)= 15 R(in/hr)= 4 Q(cfs)= 6.72

90 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	605	605	605	605	605	605	605	605	605	605	(ft/sec)
out (cf)											-
storage in forebay (cf)	409										
storage in basin (cf)	196	801	1406	2011	2616	3220	3825	4430	5035	5640	Final Q
storage head (ft) basin	0.08	0.31	0.53	0.73	0.92	1.10	1.27	1.43	1.58	1.72	-
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(ft)
adjusted slope											1.72

T(min)= 20 R(in/hr)= 3.6 Q(cfs)= 6.05

120 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	726	726	726	726	726	726	726	726	726	726	(ft/sec)
out (cf)											-
storage in forebay (cf)	409										
storage in basin (cf)	317	1043	1769	2495	3220	3946	4672	5398	6123	6849	Final Q
storage head (ft) basin	0.12	0.40	0.65	0.88	1.10	1.30	1.50	1.66	1.83	1.99	-
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(ft)
adjusted slope											1.99

T(min)= 95 R(in/hr)= 1.4 Q(cfs)= 2.35

570 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	1341	1341	1341	1341	1341	1341	1341	1341	1341	1341	(ft/sec)
out (cf)									16	201	1.167
storage in forebay (cf)	409										Final Q
storage in basin (cf)	932	2272	3613	4954	6294	7635	8975	10316	11641	12780	(cfs)
storage head (ft) basin	0.36	0.81	1.21	1.56	1.86	2.14	2.39	2.63	2.86	3.05	1.041
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.36	0.55	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.58	4.32	6.62	(ft)
adjusted slope											3.05

T(min)= 105 R(in/hr)= 1.3 Q(cfs)= 2.18

FIGURE 12

630 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	1376	1376	1376	1376	1376	1376	1376	1376	1376	1376	(ft/sec)
out (cf)									39	311	1.266
storage in forebay (cf)	409										Final Q
storage in basin (cf)	967	2343	3719	5095	6471	7847	9222	10598	11935	13000	(cfs)
storage head (ft) basin	0.37	0.83	1.24	1.60	1.90	2.18	2.44	2.68	2.91	3.09	1.256
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.41	0.59	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.17	4.93	7.13	(ft)
adjusted slope											3.09

T(min)= 120 R(in/hr)= 1.2 Q(cfs)= 2.02

720 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	1452	1452	1452	1452	1452	1452	1452	1452	1452	1452	(ft/sec)
out (cf)								1	140	614	1.376
storage in forebay (cf)	409										Final Q
storage in basin (cf)	1043	2495	3946	5398	6849	8301	9752	11203	12514	13352	(cfs)
storage head (ft) basin	0.40	0.88	1.30	1.66	1.99	2.26	2.53	2.78	3.01	3.14	1.522
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.28	0.51	0.64	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.42	3.42	6.12	7.69	(ft)
adjusted slope											3.14

T(min)= 130 R(in/hr)= 1.1 Q(cfs)= 1.85

780 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	1441	1441	1441	1441	1441	1441	1441	1441	1441	1441	(ft/sec)
out (cf)								0	134	622	1.339
storage in forebay (cf)	409										Final Q
storage in basin (cf)	1033	2474	3916	5357	6799	8240	9682	11123	12430	13250	(cfs)
storage head (ft) basin	0.40	0.88	1.29	1.65	1.98	2.25	2.52	2.77	3.00	3.12	1.428
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.27	0.50	0.62	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.27	3.25	5.96	7.50	(ft)
adjusted slope											3.12

T(min)= 140 R(in/hr)= 1 Q(cfs)= 1.68

840 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	(ft/sec)
out (cf)								0	94	541	1.263
storage in forebay (cf)	409										Final Q
storage in basin (cf)	1003	2414	3825	5236	6648	8059	9470	10881	12198	13068	(cfs)
storage head (ft) basin	0.38	0.86	1.27	1.63	1.94	2.22	2.48	2.73	2.96	3.10	1.250
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.46	0.60	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.75	5.48	7.16	(ft)
adjusted slope											3.10

FIGURE 12

Detention Basin B- Putnam design

Project 115-121

* Calculations based on CT Stormwater Quality Manual 10 yr storm.

Inlet pipe: 18" RCP @ inv. 246.10

Oulet swale: Turf Channel, inv. @ elev. 244.5, S= .01

Total AI in(pavement + grass): 2.02

Depth of Basin: 6 ft

Turf Channel: 3 ft

length of chann 12 ft

	Basin	elevation	area in sf at elev.	CF per increment	Total Vol.- cf
Forebay	0	241.0	38		
	1	242.0	132	85	85
	2	243.0	249	191	276
	3	244.0	558	404	679
Basin	0	240.0	314		
	1	241.0	522	418	418
	2	242.0	777	650	1068
	3	243.0	1080	929	1996
	4	244.0	1418	1249	3245
	5	245.0	2299	1859	5104
	6	246.0	2931	2615	7719
	6.5	246.5	3319	1563	9281
	7	247.0	3873	1798	11079

T(min)= 15 R(in/hr)= 4 Q(cfs)= 8.08

90 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	727	727	727	727	727	727	727	727	727	727	(ft/sec)
out (cf)											-
storage in forebay (cf)	679										
storage in basin (cf)	48	775	1503	2230	2957	3684	4411	5139	5866	6593	Final Q
storage head (ft) basin	0.43	1.55	2.47	3.19	3.77	4.24	4.63	5.01	5.29	5.57	-
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(ft)
adjusted slope											5.57

T(min)= 20 R(in/hr)= 3.6 Q(cfs)= 7.27

120 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	873	873	873	873	873	873	873	873	873	873	(ft/sec)
out (cf)											0.372
storage in forebay (cf)	679										
storage in basin (cf)	194	1066	1939	2812	3684	4557	5429	6302	7175	8047	Final Q
storage head (ft) basin	0.46	2.00	2.94	3.65	4.24	4.71	5.12	5.46	5.79	6.11	0.094
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.26	(ft)
adjusted slope											6.11

T(min)= 25 R(in/hr)= 3.2 Q(cfs)= 6.46

150 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	970	970	970	970	970	970	970	970	970	970	(ft/sec)
out (cf)										14	0.753
storage in forebay (cf)	679										
storage in basin (cf)	291	1260	2230	3199	4169	5139	6108	7078	8047	9003	Final Q
storage head (ft) basin	0.70	2.21	3.19	3.96	4.50	5.01	5.38	5.75	6.21	6.41	0.512
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.41	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.53	4.93	(ft)
adjusted slope											6.41

FIGURE 12

T(min)= 30 R(in/hr)= 2.8 Q(cfs)= 5.66

180 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	1018	1018	1018	1018	1018	1018	1018	1018	1018	1018	(ft/sec)
out (cf)										25	1.038
storage in forebay (cf)	679										
storage in basin (cf)	339	1357	2375	3393	4411	5429	6448	7466	8484	9477	Final Q
storage head (ft) basin	0.81	2.31	3.30	4.08	4.63	5.12	5.51	5.90	6.24	6.55	1.093
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.55	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.94	6.65	(ft)
adjusted slope											6.55

T(min)= 40 R(in/hr)= 2.5 Q(cfs)= 5.05

240 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	1212	1212	1212	1212	1212	1212	1212	1212	1212	1212	(ft/sec)
out (cf)								0	127	525	1.809
storage in forebay (cf)	679										
storage in basin (cf)	533	1745	2957	4169	5381	6593	7805	9017	10102	10789	Final Q
storage head (ft) basin	1.18	2.73	3.77	4.50	5.11	5.57	6.03	6.42	6.73	6.92	3.944
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.42	0.73	0.92	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.33	4.99	8.74	11.03	(ft)
adjusted slope											6.92

T(min)= 50 R(in/hr)= 2.1 Q(cfs)= 4.24

300 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	1273	1273	1273	1273	1273	1273	1273	1273	1273	1273	(ft/sec)
out (cf)								15	346	872	1.825
storage in forebay (cf)	679										
storage in basin (cf)	594	1866	3139	4411	5684	6957	8229	9487	10413	10814	Final Q
storage head (ft) basin	1.27	2.86	3.91	4.63	5.22	5.71	6.16	6.57	6.81	6.93	4.026
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.57	0.81	0.93	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	1.96	6.79	9.78	11.12	(ft)
adjusted slope											6.93

T(min)= 55 R(in/hr)= 2 Q(cfs)= 4.04

330 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	1333	1333	1333	1333	1333	1333	1333	1333	1333	1333	(ft/sec)
out (cf)								76	595	1165	1.827
storage in forebay (cf)	679										
storage in basin (cf)	654	1987	3321	4654	5987	7320	8653	9911	10649	10817	Final Q (cfs)
storage head (ft) basin	1.36	2.99	4.04	4.76	5.34	5.85	6.30	6.68	6.88	6.93	4.035
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.68	0.88	0.93	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	3.59	8.10	10.56	11.13	(ft)
adjusted slope											6.93

T(min)= 60 R(in/hr)= 1.8 Q(cfs)= 3.64

360 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	1309	1309	1309	1309	1309	1309	1309	1309	1309	1309	(ft/sec)
out (cf)								50	541	1136	1.745
storage in forebay (cf)	679										
storage in basin (cf)	630	1939	3248	4557	5866	7175	8484	9743	10511	10684	Final Q (cfs)
storage head (ft) basin	1.33	2.94	4.00	4.71	5.29	5.79	6.24	6.63	6.84	6.89	3.634
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.63	0.84	0.89	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	2.94	7.54	10.10	10.68	(ft)
adjusted slope											6.89

T(min)= 65 R(in/hr)= 1.7 Q(cfs)= 3.43

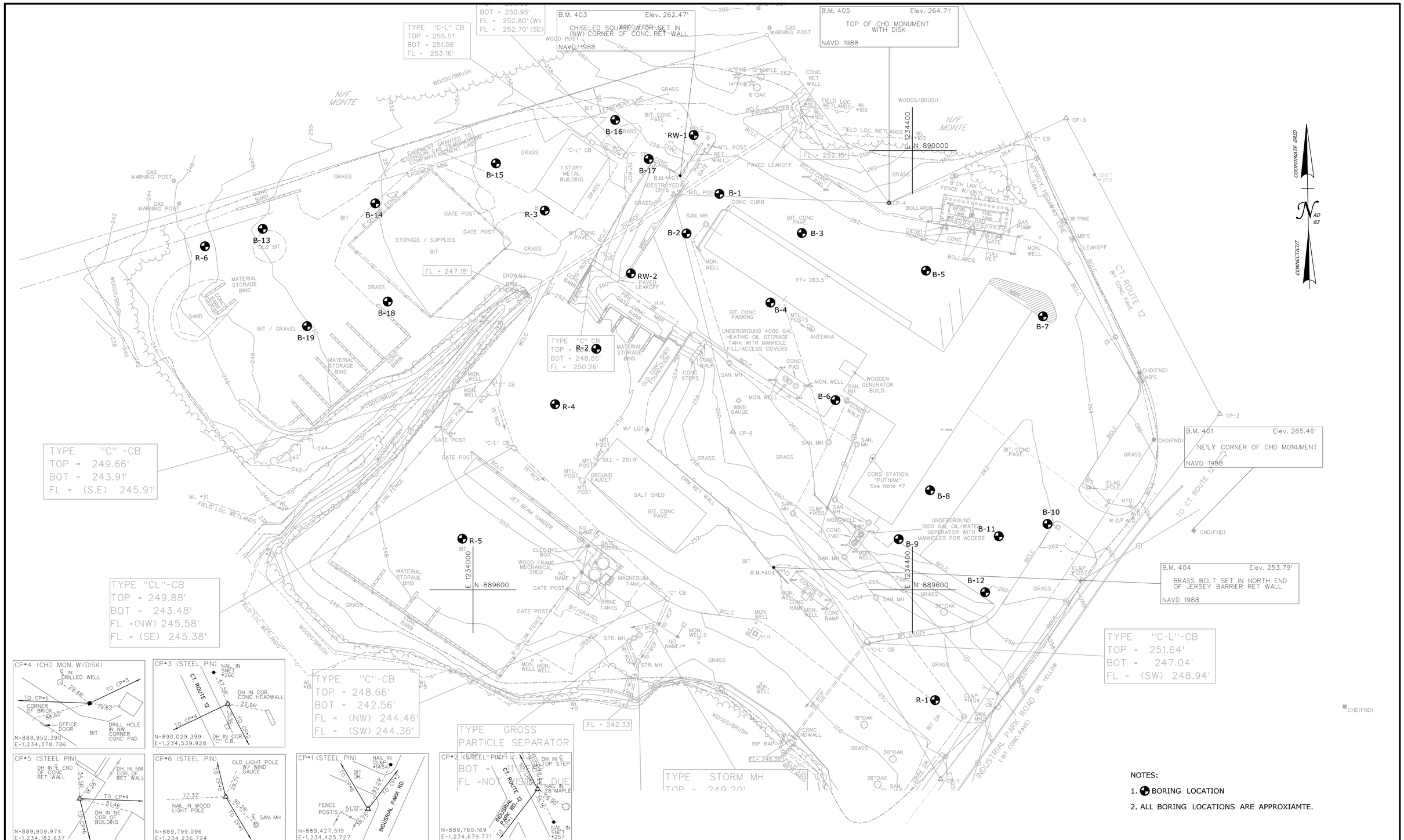
390 sec. intervals	1	2	3	4	5	6	7	8	9	10	Final Velocity
in (cf)	1339	1339	1339	1339	1339	1339	1339	1339	1339	1339	(ft/sec)
out (cf)								100	721	1277	1.703
storage in forebay (cf)	679										
storage in basin (cf)	660	2000	3339	4678	6017	7357	8696	9935	10553	10616	Final Q (cfs)
storage head (ft) basin	1.37	3.00	4.05	4.77	5.35	5.86	6.31	6.68	6.85	6.87	3.439
storage head (ft) to pipe	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.68	0.85	0.87	Basin Depth
flow depth in pipe (in)	0.00	0.00	0.00	0.00	0.00	0.00	3.75	8.18	10.25	10.45	(ft)
adjusted slope											6.87

FIGURE 12

APPENDIX C

Plan Sheets

State Project No. 0115-0121



NOTES:

1. BORING LOCATION
2. ALL BORING LOCATIONS ARE APPROXIAMTE.

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP

CHECKED BY: ME

SCALE IN FEET
0 SCALE AS NOTED 40 80
SCALE 1"=40'

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD002 (Existing).dgn

SIGNATURE/BLOCK: OFFICE OF ENGINEERING

APPROVED BY:

PROJECT TITLE: PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

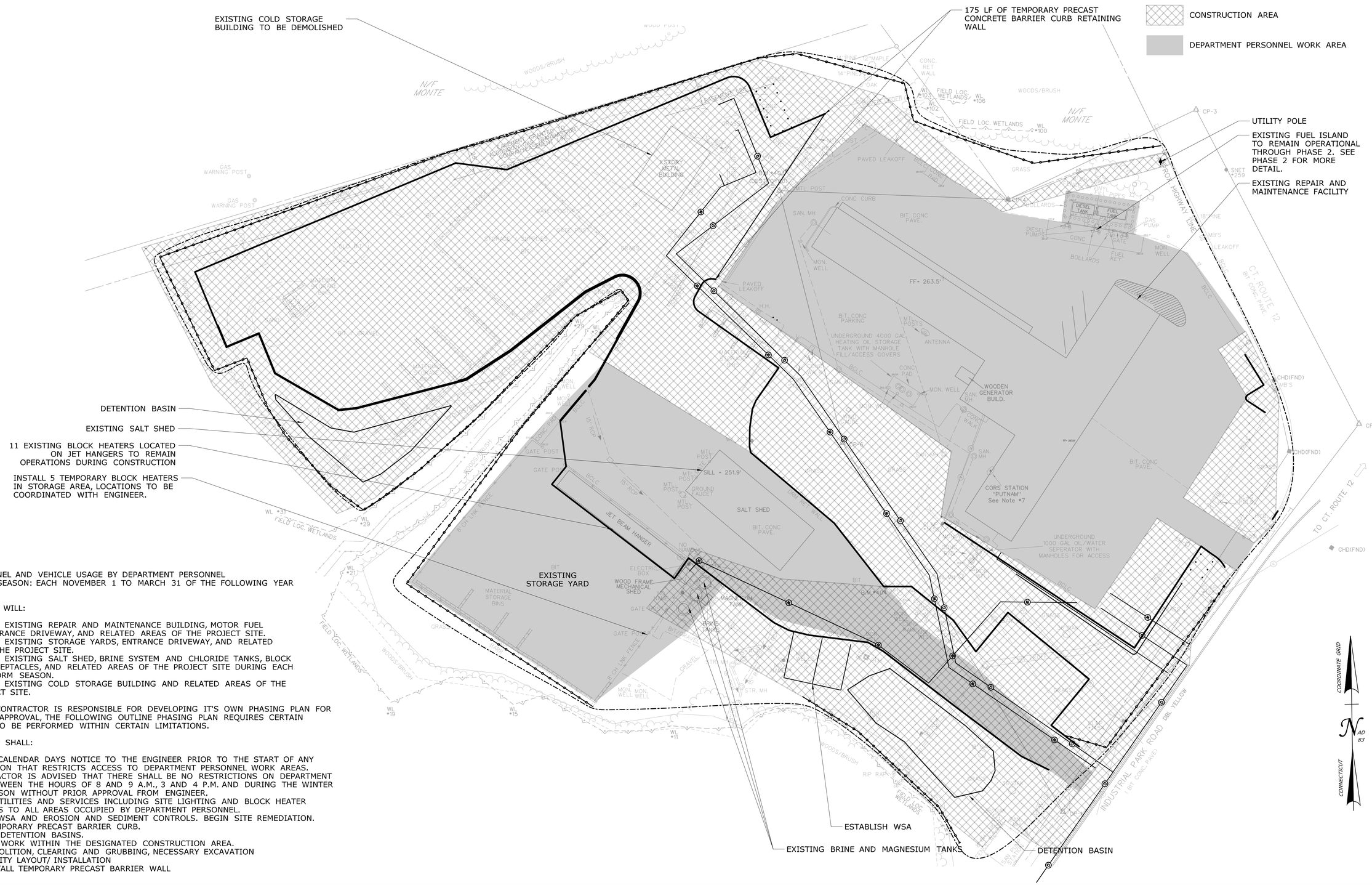
TOWN: PUTNAM

DRAWING TITLE: EXISTING CONDITIONS AND BORING LOCATIONS

PROJECT NO. 115-121

DRAWING NO. SD-002

SHEET NO. 03.02



DEFINITIONS:
OCCUPY: PERSONNEL AND VEHICLE USAGE BY DEPARTMENT PERSONNEL
WINTER STORM SEASON: EACH NOVEMBER 1 TO MARCH 31 OF THE FOLLOWING YEAR

PHASE 1 NOTES:
THE DEPARTMENT WILL:

A. OCCUPY THE EXISTING REPAIR AND MAINTENANCE BUILDING, MOTOR FUEL ISLAND, ENTRANCE DRIVEWAY, AND RELATED AREAS OF THE PROJECT SITE.
B. OCCUPY THE EXISTING STORAGE YARDS, ENTRANCE DRIVEWAY, AND RELATED AREAS OF THE PROJECT SITE.
C. OCCUPY THE EXISTING SALT SHED, BRINE SYSTEM AND CHLORIDE TANKS, BLOCK HEATER RECEPTACLES, AND RELATED AREAS OF THE PROJECT SITE DURING EACH WINTER STORM SEASON.
D. VACATE THE EXISTING COLD STORAGE BUILDING AND RELATED AREAS OF THE PROJECT SITE.

ALTHOUGH THE CONTRACTOR IS RESPONSIBLE FOR DEVELOPING IT'S OWN PHASING PLAN FOR THE ENGINEER'S APPROVAL, THE FOLLOWING OUTLINE PHASING PLAN REQUIRES CERTAIN PROJECT WORK TO BE PERFORMED WITHIN CERTAIN LIMITATIONS.

THE CONTRACTOR SHALL:

A. PROVIDE 3 CALENDAR DAYS NOTICE TO THE ENGINEER PRIOR TO THE START OF ANY CONSTRUCTION THAT RESTRICTS ACCESS TO DEPARTMENT PERSONNEL WORK AREAS. THE CONTRACTOR IS ADVISED THAT THERE SHALL BE NO RESTRICTIONS ON DEPARTMENT ACCESS BETWEEN THE HOURS OF 8 AND 9 A.M., 3 AND 4 P.M. AND DURING THE WINTER STORM SEASON WITHOUT PRIOR APPROVAL FROM ENGINEER.
B. MAINTAIN UTILITIES AND SERVICES INCLUDING SITE LIGHTING AND BLOCK HEATER RECEPTACLES TO ALL AREAS OCCUPIED BY DEPARTMENT PERSONNEL.
C. ESTABLISH WSA AND EROSION AND SEDIMENT CONTROLS. BEGIN SITE REMEDIATION.
D. INSTALL TEMPORARY PRECAST BARRIER CURB.
E. CONSTRUCT DETENTION BASINS.
F. BEGIN SITE WORK WITHIN THE DESIGNATED CONSTRUCTION AREA.
   1. DEMOLITION, CLEARING AND GRUBBING, NECESSARY EXCAVATION
   2. UTILITY LAYOUT/ INSTALLATION
   3. INSTALL TEMPORARY PRECAST BARRIER WALL

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME
SCALE IN FEET 0 40 80
SCALE 1"=40'

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

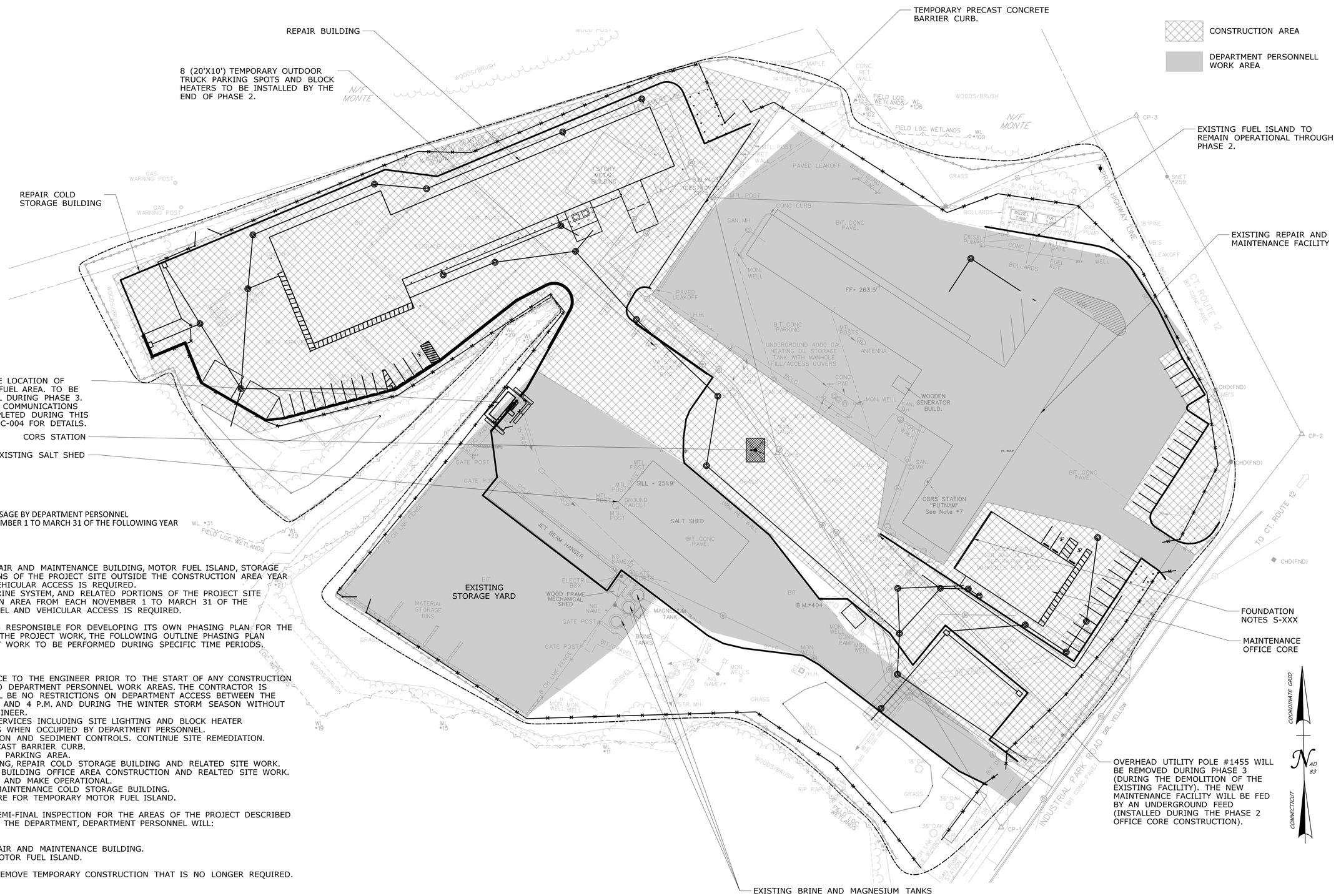
Filename: ...\FD_MSH_SD_0115_0121_SD003 (Phase 1).dgn

SIGNATURE/ BLOCK: OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE: PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM
DRAWING TITLE: PHASE 1

PROJECT NO. 115-121
DRAWING NO. SD-003
SHEET NO. 03.03



DEFINITION:
OCCUPY: PERSONNEL AND VEHICLE USAGE BY DEPARTMENT PERSONNEL
WINTER STORM SEASON: EACH NOVEMBER 1 TO MARCH 31 OF THE FOLLOWING YEAR

PHASE 2:
THE ENGINEER WILL:

A. OCCUPY THE EXISTING REPAIR AND MAINTENANCE BUILDING, MOTOR FUEL ISLAND, STORAGE YARDS AND OTHER PORTIONS OF THE PROJECT SITE OUTSIDE THE CONSTRUCTION AREA YEAR ROUND. PERSONNEL AND VEHICULAR ACCESS IS REQUIRED.
B. OCCUPY THE SALT SHED, BRINE SYSTEM, AND RELATED PORTIONS OF THE PROJECT SITE OUTSIDE THE CONSTRUCTION AREA FROM EACH NOVEMBER 1 TO MARCH 31 OF THE FOLLOWING YEAR. PERSONNEL AND VEHICULAR ACCESS IS REQUIRED.

ALTHOUGH THE CONTRACTOR IS RESPONSIBLE FOR DEVELOPING ITS OWN PHASING PLAN FOR THE ENGINEER'S APPROVAL FOR THE PROJECT WORK, THE FOLLOWING OUTLINE PHASING PLAN REQUIRES CERTAIN PROJECT WORK TO BE PERFORMED DURING SPECIFIC TIME PERIODS.

THE CONTRACTOR SHALL:

A. PROVIDE 3 CALENDAR NOTICE TO THE ENGINEER PRIOR TO THE START OF ANY CONSTRUCTION THAT RESTRICTS ACCESS TO DEPARTMENT PERSONNEL WORK AREAS. THE CONTRACTOR IS ADVISED THAT THERE SHALL BE NO RESTRICTIONS ON DEPARTMENT ACCESS BETWEEN THE HOURS OF 8 AND 9 A.M., 3 AND 4 P.M. AND DURING THE WINTER STORM SEASON WITHOUT PRIOR APPROVAL FROM ENGINEER.
B. MAINTAIN UTILITIES AND SERVICES INCLUDING SITE LIGHTING AND BLOCK HEATER RECEPTACLES TO ALL AREAS WHEN OCCUPIED BY DEPARTMENT PERSONNEL.
C. MAINTAIN WSA AND EROSION AND SEDIMENT CONTROLS. CONTINUE SITE REMEDIATION.
D. MAINTAIN TEMPORARY PRECAST BARRIER CURB.
E. INSTALL TEMPORARY REPAIR PARKING AREA.
F. CONSTRUCT REPAIR BUILDING, REPAIR COLD STORAGE BUILDING AND RELATED SITE WORK.
G. CONSTRUCT MAINTENANCE BUILDING OFFICE AREA CONSTRUCTION AND REALTED SITE WORK.
H. CONSTRUCT CORS STATION AND MAKE OPERATIONAL.
I. BEGIN CONSTRUCTION OF MAINTENANCE COLD STORAGE BUILDING.
J. CONSTRUCT INFRASTRUCTURE FOR TEMPORARY MOTOR FUEL ISLAND.

THE ENGINEER WILL HOLD A SEMI-FINAL INSPECTION FOR THE AREAS OF THE PROJECT DESCRIBED ABOVE. ONCE ACCEPTED BY THE DEPARTMENT, DEPARTMENT PERSONNEL WILL:

A. OCCUPY THESE AREAS.
B. VACATE THE EXISTING REPAIR AND MAINTENANCE BUILDING.
C. ABANDON THE EXISTING MOTOR FUEL ISLAND.

AND THE CONTRACTOR SHALL REMOVE TEMPORARY CONSTRUCTION THAT IS NO LONGER REQUIRED.

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME
SCALE IN FEET 0 40 80
SCALE 1"=40'

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

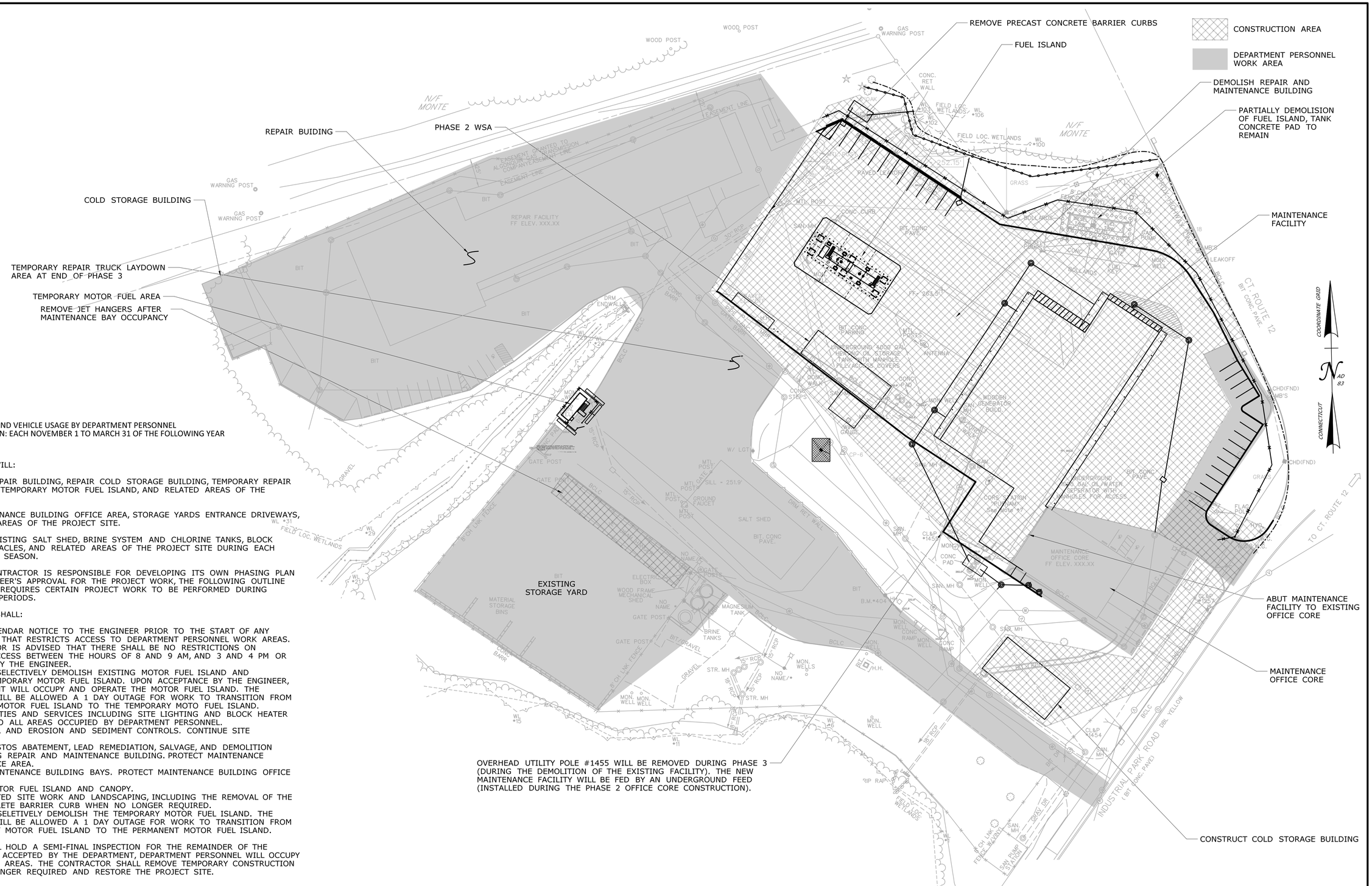
Filename: ...\FD_MSH_SD_0115_0121_SD004 (Phase 2).dgn

SIGNATURE/ BLOCK: OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE: PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM
DRAWING TITLE: PHASE 2

PROJECT NO. 115-121
DRAWING NO. SD-004
SHEET NO. 03.04



DEFINITION:
OCCUPY: PERSONNEL AND VEHICLE USAGE BY DEPARTMENT PERSONNEL
WINTER STORM SEASON: EACH NOVEMBER 1 TO MARCH 31 OF THE FOLLOWING YEAR

PHASE 3:
THE DEPARTMENT WILL:

A. OCCUPY THE REPAIR BUILDING, REPAIR COLD STORAGE BUILDING, TEMPORARY REPAIR PARKING AREA, TEMPORARY MOTOR FUEL ISLAND, AND RELATED AREAS OF THE PROJECT SITE.

B. OCCUPY MAINTENANCE BUILDING OFFICE AREA, STORAGE YARDS ENTRANCE DRIVEWAYS, AND RELATED AREAS OF THE PROJECT SITE.

C. OCCUPY THE EXISTING SALT SHED, BRINE SYSTEM AND CHLORINE TANKS, BLOCK HEATER RECEPTACLES, AND RELATED AREAS OF THE PROJECT SITE DURING EACH WINTER STORM SEASON.

ALTHOUGH THE CONTRACTOR IS RESPONSIBLE FOR DEVELOPING ITS OWN PHASING PLAN FOR THE ENGINEER'S APPROVAL FOR THE PROJECT WORK, THE FOLLOWING OUTLINE PHASING PLAN REQUIRES CERTAIN PROJECT WORK TO BE PERFORMED DURING SPECIFIC TIME PERIODS.

THE CONTRACTOR SHALL:

A. PROVIDE 3 CALENDAR NOTICE TO THE ENGINEER PRIOR TO THE START OF ANY CONSTRUCTION THAT RESTRICTS ACCESS TO DEPARTMENT PERSONNEL WORK AREAS. THE CONTRACTOR IS ADVISED THAT THERE SHALL BE NO RESTRICTIONS ON DEPARTMENT ACCESS BETWEEN THE HOURS OF 8 AND 9 AM, AND 3 AND 4 PM OR AS DIRECTED BY THE ENGINEER.
B. SALVAGE AND SELECTIVELY DEMOLISH EXISTING MOTOR FUEL ISLAND AND CONSTRUCT TEMPORARY MOTOR FUEL ISLAND. UPON ACCEPTANCE BY THE ENGINEER, THE DEPARTMENT WILL OCCUPY AND OPERATE THE MOTOR FUEL ISLAND. THE CONTRACTOR WILL BE ALLOWED A 1 DAY OUTAGE FOR WORK TO TRANSITION FROM THE EXISTING MOTOR FUEL ISLAND TO THE TEMPORARY MOTO FUEL ISLAND.
C. MAINTAIN UTILITIES AND SERVICES INCLUDING SITE LIGHTING AND BLOCK HEATER RECEPTACLES TO ALL AREAS OCCUPIED BY DEPARTMENT PERSONNEL.
D. ESTABLISH WSA AND EROSION AND SEDIMENT CONTROLS. CONTINUE SITE REMEDIATION.
E. PERFORM ASBESTOS ABATEMENT, LEAD REMEDIATION, SALVAGE, AND DEMOLITION OFTHE EXISTING REPAIR AND MAINTENANCE BUILDING. PROTECT MAINTENANCE BUILDING OFFICE AREA.
F. CONSTRUCT MAINTENANCE BUILDING BAYS. PROTECT MAINTENANCE BUILDING OFFICE AREA.
G. CONSTRUCT MOTOR FUEL ISLAND AND CANOPY.
H. PERFORM RELATED SITE WORK AND LANDSCAPING, INCLUDING THE REMOVAL OF THE PRECAST CONCRETE BARRIER CURB WHEN NO LONGER REQUIRED.
I. SALVAGE AND SELETIVELY DEMOLISH THE TEMPORARY MOTOR FUEL ISLAND. THE CONTRACTOR WILL BE ALLOWED A 1 DAY OUTAGE FOR WORK TO TRANSITION FROM THE TEMPORARY MOTOR FUEL ISLAND TO THE PERMANENT MOTOR FUEL ISLAND.

THE ENGINEER WILL HOLD A SEMI-FINAL INSPECTION FOR THE REMAINDER OF THE PROJECT. ONCE ACCEPTED BY THE DEPARTMENT, DEPARTMENT PERSONNEL WILL OCCUPY THE REMAINING AREAS. THE CONTRACTOR SHALL REMOVE TEMPORARY CONSTRUCTION THAT IS NO LONGER REQUIRED AND RESTORE THE PROJECT SITE.

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 6/3/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME
SCALE IN FEET 0 40 80
SCALE 1"=40'

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD005 (Phase 3).dgn

SIGNATURE/BLOCK: OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE: PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM
DRAWING TITLE: PHASE 3

PROJECT NO. 115-121
DRAWING NO. SD-005
SHEET NO. 03.05

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: B-01	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889961	
Start Date: 8-29-17	Route No.: 12	Easting: 1234224	
Finish Date: 8-30-17	Bridge No.: NA	Surface Elevation: 262.8	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @15.75 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	9 16 12 11	24	18		PAVEMENT STRUCTURE/ MISC. FILL	Brown C-F SAND, some f-c gravel, trace silt	260
5	S-2	7 4 3 3	24	9			Brown C-F SAND, some f-c gravel, trace silt with cobbles	255
10	S-3	11 6 5 5	24	5			Dark Brown C-F SAND, some f-c gravel, trace silt with cobbles	250
15	S-4	35 42 32 24	24	2		GRAVELLY SAND	Gray COBBLES	245
20	S-5	19 12 11 13	24	14			Brown C-F SAND, some f gravel, trace silt with cobbles	240
25	S-6	19 24 19 16	24	4		GLACIAL TILL	White COBBLES	235
30	S-7	13 24 25 25	24	16			Tan F-C SAND, some f-c gravel, trace silt with cobbles	230
35	S-8	14 13 14 17	24	16			Tan F-C SAND, some f-c gravel, trace silt with cobbles	225
40	S-9	54 100	12	10			Gray C-F GRAVEL, trace c-f sand, trace silt with	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 40.75ft Rock: 10ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement. Advanced through 6" of cobbles at approximate depth of 20' below ground surface.	Sheet 1 of 2
No. of Soil Samples: 9 No. of Core Runs: 4		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: B-01	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889961	
Start Date: 8-29-17	Route No.: 12	Easting: 1234224	
Finish Date: 8-30-17	Bridge No.: NA	Surface Elevation: 262.8	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @15.75 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40							cobbles	
	C-1		42	24	0	BEDROCK	Gray medium grained, medium bedded, intensely fractured, moderately weathered Gneiss Core Times (min/ft): 2.5, 1.5, 2.0, 3.5	220
45	C-2		18	20	60		Gray medium grained, medium bedded, highly fractured, moderately weathered Gneiss Core Times (min/ft): 1.5, 2.5	
	C-3		42	33	18		Gray medium grained, medium bedded, intensely fractured, moderately weathered Gneiss Core Times (min/ft): 2.5, 2.5, 4.5, 5.0	215
50	C-4		18	21	33		Gray medium grained, medium bedded, intensely fractured, moderately weathered Gneiss Core Times (min/ft): 1.0, 2.5	210
55							END OF BORING 50.75ft	205
60								200
65								195
70								190
75								185
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 40.75ft Rock: 10ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement. Advanced through 6" of cobbles at approximate depth of 20' below ground surface.	Sheet 2 of 2
No. of Soil Samples: 9 No. of Core Runs: 4		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: B-02	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889925	
Start Date: 9-7-17	Route No.: 12	Easting: 1234195	
Finish Date: 9-7-17	Bridge No.: NA	Surface Elevation: 262.8	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @10 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	12 16 13 16	24	18		PAVEMENT STRUCTURE/ MISC. FILL	Brown C-F SAND, little f-c gravel, trace silt	260
5	S-2	9 5 6 7	24	11			Brown C-F SAND, some f-c gravel, trace silt	255
10	S-3	1 1 14 42	24	8			Gray C-F SAND AND C-F GRAVEL, trace silt with concrete pieces	250
15	S-4	14 19 19 21	24	1		GRAVELLY SAND	Brown C-F SAND, trace f gravel, trace silt	
	S-5	14 22 18 19	24	13			Brown C-F SAND AND C-F GRAVEL, trace silt	245
20	S-6	13 16 16 18	24	17			Brown C-F SAND AND C-F GRAVEL, trace silt	240
25	S-7	9 8 10 12	24	8			Brown C-F SAND AND C-F GRAVEL, trace silt	235
30	S-8	16 82	11	6		GLACIAL TILL	Tan F-C SAND AND C-F GRAVEL, trace silt	230
35	S-9	18 25 22 22	24	14			Tan F-C SAND, little f-c gravel, trace silt	225
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 44.2ft Rock: 10ft	NOTES: Pavement structure consists of 4.5" of bituminous concrete pavement. Roller bit through 18" of boulder at approximate depth of 30' below ground surface.	Sheet 1 of 2
No. of Soil Samples: 11 No. of Core Runs: 2		SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD006 (Boring Logs 1).dgn

SIGNATURE/ BLOCK:
OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE:
PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: BORING LOGS

PROJECT NO. 115-121
DRAWING NO. SD-006
SHEET NO. 03.06

Connecticut DOT Boring Report

Driller:	Nick Kenny	Hole No.:	B-02
Inspector:	Glenn L. Arzt	Town:	Putnam, Connecticut
Stat./Offset:			
Engineer:	Sara Gahtee	Project No.:	0115-0121
Northing:	889925		
Start Date:	9-7-17	Route No.:	12
Easting:	1234195		
Finish Date:	9-7-17	Bridge No.:	NA
Surface Elevation:	262.8		

Project Description: Putnam Maintenance Facility Renovation

Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.	

Groundwater Observations: @10 after 0 hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40	S-10	13 13 17 15	24	12		GLACIAL TILL (con't)	Tan F-C SAND, some c-f Gravel, little silt	220
45	S-11	50	0	0		BEDROCK	Gray - C GRAVEL, some f-c sand, trace silt	
	C-1		60	36	40		Gray medium grained, medium bedded, highly fractured, moderately weathered Gneiss Core Times (min/ft): 3.5, 4.0, 2.5, 2.5, 4.0	215
50	C-2		60	58	88		Gray medium grained, medium bedded, moderately fractured, moderately weathered Gneiss Core Times (min/ft): 3.0, 3.0, 3.5, 3.0, 2.5	210
55							END OF BORING 54.2ft	205
60								200
65								195
70								190
75								185
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 44.2ft Rock: 10ft	NOTES: Pavement structure consists of 4.5" of bituminous concrete pavement. Roller bit through 18" of boulder at approximate depth of 30' below ground surface.	Sheet 2 of 2
No. of Soil Samples: 11 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller:	Nick Kenny	Hole No.:	B-03
Inspector:	Glenn L. Arzt	Town:	Putnam, Connecticut
Stat./Offset:			
Engineer:	Sara Gahtee	Project No.:	0115-0121
Northing:	889925		
Start Date:	9-12-17	Route No.:	12
Easting:	1234299		
Finish Date:	9-12-17	Bridge No.:	NA
Surface Elevation:	263.0		

Project Description: Putnam Maintenance Facility Renovation

Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.	

Groundwater Observations: @14.25 after 0 hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	12 16 13 15	24	17		PAVEMENT STRUCTURE/ MISC. FILL	Brown C-F SAND, some f-c gravel, trace silt	260
5	S-2	8 4 3 3	24	0			Brown C-F SAND, some c-f gravel, trace silt	
	S-3	2 2 3 5	24	9			Brown C-F SAND AND C-F GRAVEL, trace silt	255
10	S-4	8 6 9 11	24	0		GRAVELLY SAND	Gray COBBLES	
	S-5	4 6 13 11	24	4			Brown F-C SAND, some c-f gravel, trace silt with cobbles	250
15	S-6	10 15 15 21	24	0			Gray COBBLES	
	S-7	3 4 3 10	24	11			Tan F-C SAND, some c-f Gravel, little silt	245
20	S-8	19 24 44 39	24	10		GLACIAL TILL	Tan C-F GRAVEL, little c-f sand, trace silt	240
25	S-9	22 29 19 24	24	13			Brown C-F SAND, some f-c gravel, trace silt	
30	S-10	19 88	10	3			Gray C-F GRAVEL AND C-F SAND, trace silt	235
35	S-11	70	1	0			Gray C-F SAND AND F-C GRAVEL, little Silt	230
	S-12	100	2	0			Gray F-C GRAVEL AND C-F SAND, little Silt	
	S-13	100	3	1			Gray F GRAVEL, some c-f sand, trace silt	
	S-14	100	1	1			Gray C-F SAND, some f-c gravel, trace silt	225
40	S-15	100	5	5			Gray C-F SAND AND C-F GRAVEL, trace silt	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 43ft Rock: 9.75ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement.	Sheet 1 of 2
No. of Soil Samples: 16 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller:	Nick Kenny	Hole No.:	B-03
Inspector:	Glenn L. Arzt	Town:	Putnam, Connecticut
Stat./Offset:			
Engineer:	Sara Gahtee	Project No.:	0115-0121
Northing:	889925		
Start Date:	9-12-17	Route No.:	12
Easting:	1234299		
Finish Date:	9-12-17	Bridge No.:	NA
Surface Elevation:	263.0		

Project Description: Putnam Maintenance Facility Renovation

Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.	

Groundwater Observations: @14.25 after 0 hours

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40						GLACIAL TILL (con't)		
	S-16	50	0	0		BEDROCK	Gray C-F GRAVEL AND C-F SAND, little Silt	220
45	C-1		60	47	0		Gray - medium grained, medium bedded, highly fractured, moderately weathered Gneiss Core Times (min/ft): 2.5, 2.5, 3.0, 3.5, 3.5	215
50	C-2		57	42	8		Gray - medium grained, medium bedded, highly fractured, highly weathered Gneiss Core Times (min/ft): 3.0, 3.5, 3.0, 5.5, 3.5	210
55							END OF BORING 52.75ft	205
60								200
65								195
70								190
75								185
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test

Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 43ft Rock: 9.75ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement.	Sheet 2 of 2
No. of Soil Samples: 16 No. of Core Runs: 2		SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP

CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD007 (Boring Logs 2).dgn

SIGNATURE/BLOCK: OFFICE OF ENGINEERING

APPROVED BY:

PROJECT TITLE: PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: BORING LOGS

PROJECT NO. 115-121

DRAWING NO. SD-007

SHEET NO. 03.07

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: B-04	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889862	
Start Date: 9-6-17	Route No.: 12	Easting: 1234271	
Finish Date: 9-7-17	Bridge No.: NA	Surface Elevation: 263.1	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @17.5 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						PAVEMENT STRUCTURE/ MISC. FILL		
	S-1	4 4 5 8	24	17			Brown C-F SAND, some c-f gravel, trace silt	260
5	S-2	6 7 4 5	24	8			Brown C-F SAND, some c-f gravel, little silt	
								255
10	S-3	13 15 15 20	24	10		SANDY GRAVEL	Brown C-F SAND AND F-C GRAVEL, trace silt	
								250
15	S-4	17 21 14 17	24	2			Gray COBBLES	
								245
20	S-5	11 11 12 14	24	0			Gray COBBLES	
	S-6	25 21 19 21	24	0			Gray COBBLES	
								240
25	S-7	4 5 13 22	24	3			Gray C-F GRAVEL, some c-f sand, trace silt	
	S-8	16 15 21 20	24	14		GLACIAL TILL	Tan F-C SAND, some f-c gravel, trace silt	235
30	S-9	41 72 28 21	24	2			Gray COBBLES	
	S-10	13 27 100	16	8			Tan F-C SAND, some c-f Gravel, trace silt	
	S-11	50	0	0			Gray C-F GRAVEL, some c-f sand, trace silt	230
35	C-1		60	62	86	BEDROCK	Gray medium grained, medium bedded, moderately fractured, moderately weathered Gneiss Core Times (min/ft): 4.0, 2.0, 2.5, 2.0, 3.5	
								225
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 33.5ft Rock: 10ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement.	Sheet 1 of 2
No. of Soil Samples: 11 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: B-04	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889862	
Start Date: 9-6-17	Route No.: 12	Easting: 1234271	
Finish Date: 9-7-17	Bridge No.: NA	Surface Elevation: 263.1	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @17.5 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40	C-2		60	49	68	BEDROCK (cont)	Gray medium grained, medium bedded, moderately fractured, moderately weathered Gneiss Core Times (min/ft): 2.0, 2.5, 2.0, 2.0, 4.5	220
45							END OF BORING 43.5ft	
								215
50								
								210
55								
								205
60								
								200
65								
								195
70								
								190
75								
								185
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 33.5ft Rock: 10ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement.	Sheet 2 of 2
No. of Soil Samples: 11 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: B-05	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889891	
Start Date: 9-13-17	Route No.: 12	Easting: 1234412	
Finish Date: 9-13-17	Bridge No.: NA	Surface Elevation: 262.4	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @10.5 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						PAVEMENT STRUCTURE/ MISC. FILL		
	S-1	20 29 26 11	24	13			Brown C-F SAND AND C-F GRAVEL, trace silt	260
5	S-2	18 14 5 3	24	3			Gray C-F GRAVEL, some c-f sand, trace silt	
								255
10	S-3	11 7 5 7	24	4		SANDY GRAVEL	Gray C-F GRAVEL, some c-f sand, trace silt	
								250
15	S-4	30 19 13 12	24	0			Gray COBBLES	
	S-5	6 5 9 13	24	0			Gray COBBLES	245
20	S-6	14 23 20 20	24	6		GLACIAL TILL	Tan C-F GRAVEL AND F-C SAND, trace silt	
								240
25	S-7	11 16 22 50	24	20			Tan C-F SAND AND C-F GRAVEL, trace silt	
						BEDROCK		235
30	C-1		60	45	54		Gray medium grained, medium bedded, highly fractured, moderately weathered Gneiss Core Times (min/ft): 3.0, 2.0, 3.5, 3.5, 3.5	230
35	C-2		54	60	96		Gray medium grained, medium bedded, moderately fractured, moderately weathered Gneiss Core Times (min/ft): 4.0, 4.0, 3.0, 3.5, 3.5	
								225
40							END OF BORING 37.7ft	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 28.2ft Rock: 9.5ft	NOTES: Pavement structure consists of 6" of bituminous concrete pavement.	Sheet 1 of 1
No. of Soil Samples: 7 No. of Core Runs: 2		SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD008 (Boring Logs 3).dgn

SIGNATURE/ BLOCK:
OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE:
PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: BORING LOGS

PROJECT NO. 115-121
DRAWING NO. SD-008
SHEET NO. 03.08

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: B-06	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889773	
Start Date: 8-31-17	Route No.: 12	Easting: 1234330	
Finish Date: 9-6-17	Bridge No.: NA	Surface Elevation: 262.9	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @21 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0								
	S-1	3 6 5 7	24	12		PAVEMENT STRUCTURE/ MISC. FILL	Brown C-F SAND AND C-F GRAVEL, trace silt	260
5	S-2	11 8 8 9	24	12			Brown C-F SAND, little f gravel, trace silt	255
10	S-3	9 12 14 18	24	15		GRAVELLY SAND	Brown C-F SAND, some f-c gravel, trace silt	250
15	S-4	7 4 7 11	24	11			Brown C-F SAND, some f-c gravel, trace silt	245
20	S-5	16 11 10 11	24	10			Tan C-F SAND AND F-C GRAVEL, trace silt	240
25	S-6	15 19 26 19	24	13		GLACIAL TILL	Brown C-F SAND AND C-F GRAVEL, trace silt	235
30	S-7	17 25 28 26	24	3			Tan C GRAVEL, some f-c Sand, trace silt	230
35	S-8	21 28 22 16	24	11			Tan F-C SAND AND C-F GRAVEL, trace silt	225
	S-9	25 90	11	4			Gray C-F GRAVEL, little f-c sand, trace silt	
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 39.5ft Rock: 10ft	NOTES: Pavement structure consists of 3" of bituminous concrete pavement.	Sheet 1 of 2
No. of Soil Samples: 9 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: B-06	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889773	
Start Date: 8-31-17	Route No.: 12	Easting: 1234330	
Finish Date: 9-6-17	Bridge No.: NA	Surface Elevation: 262.9	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @21 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40								
	C-1		60	56	54	BEDROCK *(con't)*	Gray medium grained, medium bedded, highly fractured, moderately weathered Gneiss Core Times (min/ft): 4.5, 3.0, 9.5, 8.5, 3.5	220
45	C-2		60	58	94		Gray medium grained, medium bedded, moderately fractured, moderately weathered Gneiss Core Times (min/ft): 3.5, 3.0, 2.5, 3.0, 4.0	215
50							END OF BORING 49.5ft	210
55								205
60								200
65								195
70								190
75								185
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 39.5ft Rock: 10ft	NOTES: Pavement structure consists of 3" of bituminous concrete pavement.	Sheet 2 of 2
No. of Soil Samples: 9 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: B-07	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889849	
Start Date: 8-7-17	Route No.: 12	Easting: 1234518	
Finish Date: 8-8-17	Bridge No.: NA	Surface Elevation: 263.4	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @8.5 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0								
	S-1	11 15 15 12	24	11		PAVEMENT STRUCTURE/ MISC. FILL	Brown C-F SAND AND C-F GRAVEL, trace silt	260
5	S-2	16 13 6 8	24	3			Brown C-F GRAVEL, little c-f sand, trace silt	
						SANDY GRAVEL		255
10	S-3	5 3 5 7	24	14			Tan F SAND, trace silt	250
15	S-4	11 15 20 19	24	6		GLACIAL TILL	Tan C-F GRACEL, little f-c sand, trace silt with cobbles	245
20	S-5	50	0	0		BEDROCK	Gray C-F GRAVEL, some f-c sand, trace silt	
	C-1		60	62	86		Gray medium grained, medium bedded, highly fractured, moderately weathered Gneiss Core Times (min/ft): 3.0, 2.5, 2.5, 2.0, 2.5	240
25	C-2		60	63	98		Gray medium grained, medium bedded, highly fractured, moderately weathered Gneiss Core Times (min/ft): 2.5, 2.5, 3.0, 2.0, 2.0	235
30							END OF BORING 29ft	230
35								225
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 19ft Rock: 10ft	NOTES: Pavement structure consists of 3.5" of bituminous concrete pavement.	Sheet 1 of 1
No. of Soil Samples: 5 No. of Core Runs: 2		SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD009 (Boring Logs 4).dgn

SIGNATURE/ BLOCK:
OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE:
PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: BORING LOGS

PROJECT NO. 115-121
DRAWING NO. SD-009
SHEET NO. 03.09

Connecticut DOT Boring Report

Driller: Chris Knight		Hole No.: B-08	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889691	
Start Date: 9-19-17	Route No.: 12	Easting: 1234415	
Finish Date: 9-20-17	Bridge No.: NA	Surface Elevation: 263.0	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @19.5 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						PAVEMENT STRUCTURE/ MISC. FILL		
	S-1	17 15 9 8	24	16			Brown C-F SAND, trace f-c gravel, trace silt with cobbles	260
5	S-2	1 1 1 5	24	8			Brown C-F SAND, some c-f gravel, trace silt	
								255
10	S-3	7 9 12 17	24	10		GRAVELLY SAND	Brown C-F SAND, little f-c gravel, trace silt	
								250
15	S-4	7 9 10 11	24	13			Brown C-F SAND, some f-c gravel, trace silt	
								245
20	S-5	7 8 10 14	24	8			Brown C-F SAND, some f-c gravel, trace silt	
								240
25	S-6	6 8 23 19	24	8		GLACIAL TILL	Tan C-F GRAVEL, some f-c sand, trace silt	
								235
30	S-7	21 23 21 23	24	16			Tan F-C SAND AND C-F GRAVEL, trace silt	
								230
35	S-8	13 17 23 26	24	16			Tan C-F SAND AND F-C GRAVEL, trace silt	
								225
40	S-9	16 78	10	8			Tan C-F SAND AND C-F GRAVEL, trace silt	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 41ft Rock: 9.8ft	NOTES: Pavement structure consists of 4.5" of bituminous concrete pavement.	Sheet 1 of 2
No. of Soil Samples: 9 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Chris Knight		Hole No.: B-08	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889691	
Start Date: 9-19-17	Route No.: 12	Easting: 1234415	
Finish Date: 9-20-17	Bridge No.: NA	Surface Elevation: 263.0	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @19.5 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40						BEDROCK		
	C-1		58	58	0		Gray medium grained, medium bedded, intensely fractured, moderately weathered Gneiss Core Times (min/ft): 2.0, 2.0, 2.0, 3.0, 2.5	220
45								
	C-2		60	60	46		Gray medium grained, medium bedded, highly fractured, moderately weathered Gneiss Core Times (min/ft): 1.5, 1.5, 1.5, 1.5, 2.0	215
50								
							END OF BORING 50.83ft	210
55								
								205
60								
								200
65								
								195
70								
								190
75								
								185
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 41ft Rock: 9.8ft	NOTES: Pavement structure consists of 4.5" of bituminous concrete pavement.	Sheet 2 of 2
No. of Soil Samples: 9 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Chris Knight		Hole No.: B-09	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889647	
Start Date: 9-20-17	Route No.: 12	Easting: 1234387	
Finish Date: 9-20-17	Bridge No.: NA	Surface Elevation: 262.8	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @22.5 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						PVEMENT STRUCTURE/ MISC. FILL		
	S-1	6 9 12 10	24	17			Brown C-F SAND, some c-f gravel, trace silt	260
5	S-2	5 4 3 4	24	12			Brown C-F SAND, some f-c gravel, trace silt	
								255
10	S-3	6 7 6 7	24	13			Brown C-F SAND, little f gravel, trace silt	
						GRAVELLY SAND		250
15	S-4	10 13 14 17	24	13			Brown C-F SAND AND C-F GRAVEL, trace silt	
								245
20	S-5	19 17 10 11	24	12			Brown C-F SAND AND C-F GRAVEL, trace silt	
								240
25	S-6	8 8 10 12	24	10			Brown C-F GRAVEL AND C-F SAND, trace silt	
								235
30	S-7	60	2	0		GLACIAL TILL	Gray COBBLES	
	C-1		60	11	8	BOULDER	Gray medium grained, medium bedded, intensely fractured, moderately weathered Boulder Core Times (min/ft): 1.5, 0.5, 0.5, 0.5, 1.5	230
35	S-8	16 22 22 31	24	12		GLACIAL TILL	Tan C-F GRAVEL, scme f-c sand, trace silt	
								225
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 44.1ft Rock: 10ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement.	Sheet 1 of 2
No. of Soil Samples: 10 No. of Core Runs: 3		SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD010 (Boring Logs 5).dgn

SIGNATURE/ BLOCK:
OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE:
PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: BORING LOGS

PROJECT NO. 115-121
DRAWING NO. SD-010
SHEET NO. 03.10

Connecticut DOT Boring Report

Driller: Chris Knight		Hole No.: B-09	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889647	
Start Date: 9-20-17	Route No.: 12	Easting: 1234387	
Finish Date: 9-20-17	Bridge No.: NA	Surface Elevation: 262.8	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @22.5 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40	S-9	15 18 22 28	24	15		GLACIAL TILL (con't)	Tan C-F SAND AND C-F GRAVEL, trace silt	220
45	S-10	50	1	1		BEDROCK	Gray C-F GRAVEL, little c-f sand, trace silt	
	C-2		60	60	38		Gray medium grained, medium bedded, highly fractured, moderately weathered Gneiss Core Times (min/ft): 2.5, 2.0, 2.5, 4.0, 2.0	215
50	C-3		60	60	80		Gray medium grained, medium bedded, moderately fractured, moderately weathered Gneiss Core Times (min/ft): 1.5, 1.5, 1.5, 1.5, 1.5	210
55							END OF BORING 54.1ft	205
60								200
65								195
70								190
75								185
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 44.1ft Rock: 10ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement.	Sheet 2 of 2
No. of Soil Samples: 10 No. of Core Runs: 3		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny / Chris Knight		Hole No.: B-10	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889661	
Start Date: 9-14-17	Route No.: 12	Easting: 1234522	
Finish Date: 9-19-17	Bridge No.: NA	Surface Elevation: 261.7	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ / 3in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @12.5 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	6 4 12 11	24	12		PAVEMENT STRUCTURE/ MISC. FILL	Brown C-F SAND, some c-f gravel, trace silt	260
5	S-2	9 20 15 8	24	8		GRAVELLY SAND	Brown F-C SAND, some f-c gravel, little silt	255
10	S-3	50	0	0			No Recovery	
	S-4	4 9 11 12	24	13			Brown C-F SAND, little c-f gravel, trace silt	250
15	S-5	17 17 16 14	24	13		GLACIAL TILL	Brown C-F GRAVEL, some c-f sand, trace silt	245
20	S-6	30 30 19 17	24	10			Brown C-F SAND AND F-C GRAVEL, trace silt	240
25	S-7	11 16 46 91	22	13			Brown C-F GRAVEL AND C-F SAND, trace silt	235
30	C-1		60	56	64	BEDROCK	Gray medium grained, medium bedded, moderately fractured, moderately weathered Gneiss Core Times (min/ft): 6.0, 3.5, 2.0, 3.0, 2.5	230
35	C-2		60	58	80		Gray medium grained, medium bedded, moderately fractured, moderately weathered Gneiss Core Times (min/ft): 4.0, 2.0, 2.0, 1.5, 2.0	225
40							END OF BORING 36ft	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 26ft Rock: 10ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement. The 4in casing broke at a depth of 16.5'. The casing was extracted from the hole. A 3" casing was insterted in the hole. The hole was advanced with 3" casing from 16.5'. Roller bit through 12" of boulder at approximate depth of 9' below ground surface.	Sheet 1 of 1
No. of Soil Samples: 7 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Chris Knight		Hole No.: B-11	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889650	
Start Date: 9-20-17	Route No.: 12	Easting: 1234478	
Finish Date: 9-21-17	Bridge No.: NA	Surface Elevation: 260.6	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @12 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	11 13 11 6	24	12		PAVEMENT STRUCTURE/ MISC. FILL	Brown C-F SAND, some c-f gravel, trace silt	260
5	S-2	6 1 2 2	24	8			Brown F-C SAND, some c-f gravel, little silt	255
10	S-3	5 6 13 17	24	12		GRAVELLY SAND	Brown C-F SAND, little c-f gravel, trace silt	250
15	S-4	11 10 7 8	24	13			Brown C-F SAND, some c-f gravel, trace silt	245
20	S-5	6 7 8 13	24	9			Brown C-F SAND, trace f gravel, trace silt	240
25	S-6	15 19 20 24	24	5		GLACIAL TILL	Tan C-F SAND, some c-f gravel, trace silt	235
30	S-7	12 29 15 13	24	13			Tan C-F SAND AND C-F GRAVEL, trace silt	230
35	S-8	10 80	12	2			Tan F-C SAND, some f-c gravel, trace silt	225
40	C-1		54	42	48	BEDROCK	Gray medium grained, medium bedded, highly fractured, moderately weathered Gneiss Core Times (min/ft): 1.5, 1.5, 2.0, 2.0, 3.0	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 35ft Rock: 9ft	NOTES: Pavement structure consists of 6" of bituminous concrete pavement.	Sheet 1 of 2
No. of Soil Samples: 8 No. of Core Runs: 2		SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD011 (Boring Logs 6).dgn

SIGNATURE/ BLOCK:
OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE:
PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: BORING LOGS

PROJECT NO. 115-121
DRAWING NO. SD-011
SHEET NO. 03.11

Connecticut DOT Boring Report

Driller: Chris Knight		Hole No.: B-11	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889650	
Start Date: 9-20-17	Route No.: 12	Easting: 1234478	
Finish Date: 9-21-17	Bridge No.: NA	Surface Elevation: 260.6	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @12 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40	C-2		54	58	30	BEDROCK *(con't)*	Gray medium grained, medium bedded, highly fractured, moderately weathered Gneiss Core Times (min/ft): 1.5, 2.0, 2.0, 3.0, 3.5	220
45							END OF BORING 44ft	215
50								210
55								205
60								200
65								195
70								190
75								185
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 35ft Rock: 9ft	NOTES: Pavement structure consists of 6" of bituminous concrete pavement.	Sheet 2 of 2
No. of Soil Samples: 8 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: B-12	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889599	
Start Date: 9-14-17	Route No.: 12	Easting: 1234466	
Finish Date: 9-14-17	Bridge No.: NA	Surface Elevation: 259.9	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @11.75 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	6 9 13 10	24	12		PAVEMENT STRUCTURE/ MISC: FILL	Brown C-F SAND, little f-c gravel, trace silt	
5	S-2	13 9 6 16	24	10		GRAVELLY SAND	Brown C-F SAND, trace f gravel, trace silt	255
10	S-3	25 20 21 23	24	14			Brown C-F SAND AND C-F GRAVEL, trace Silt	250
15	S-4	13 18 19 17	24	10			Brown C-F SAND, some f-c gravel, trace silt	245
20	S-5	9 19 19 19	24	3		GLACIAL TILL	Orange C-F GRAVEL, some c-f sand, trace silt	240
25	S-6	12 17 21 19	24	14			Tan C-F GRAVEL, some f-c sand, trace silt	235
30	S-7	47 45 34 23	24	3			Tan C-F GRAVEL, some c-f sand, trace silt	230
	S-8	16 21 27 28	24	22			Brown C-F SAND AND C-F GRAVEL, trace silt	
35	S-9	13 22 18 14	24	15			Tan C-F SAND, some f-c gravel, trace silt	225
40	S-10	50	0	0		BEDROCK	WEATHERED BEDROCK	220

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 39ft Rock: 10ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement.	Sheet 1 of 2
No. of Soil Samples: 10 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: B-12	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889599	
Start Date: 9-14-17	Route No.: 12	Easting: 1234466	
Finish Date: 9-14-17	Bridge No.: NA	Surface Elevation: 259.9	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @11.75 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40	C-1		60	32	8	BEDROCK *(con't)*	Gray medium grained, medium bedded, intensely fractured, moderately weathered Gneiss Core Times (min/ft): 3.0, 3.0, 3.5, 2.0, 3.0	
45	C-2		60	44	0		Gray medium grained, medium bedded, intensely fractured, moderately weathered Gneiss Core Times (min/ft): 2.0, 3.0, 3.0, 3.0, 3.5	215
50							END OF BORING 49ft	210
55								205
60								200
65								195
70								190
75								185
80								180

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 39ft Rock: 10ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement.	Sheet 2 of 2
No. of Soil Samples: 10 No. of Core Runs: 2		SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: **KP**
CHECKED BY: **ME**

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD012 (Boring Logs 7).dgn

SIGNATURE/BLOCK: **OFFICE OF ENGINEERING**
APPROVED BY:

PROJECT TITLE: **PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY**

TOWN: **PUTNAM**
DRAWING TITLE: **BORING LOGS**

PROJECT NO. **115-121**
DRAWING NO. **SD-012**
SHEET NO. **03.12**

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-13	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 889930.3	
Start Date: 8-22-19	Route No.: 12	Easting: 1233808.3	
Finish Date: 8-22-19	Bridge No.: NA	Surface Elevation: 250.4	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ/3in HFJ	Sampler Type/Size: 2in SS	Core Barrel Type: NX2	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @11.1 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						PAVEMENT STRUCTURE/ MISC. FILL		250
5	S-1	10 10 11 13	24	10		GRAVELLY SAND	Brown c-f SAND and f-c GRAVEL, trace silt	245
10	S-2	6 5 4 2	24	10			Brown f SAND, little Silt	240
15	S-3	17 13 10 12	24	8			Brown c-f SAND and c-f GRAVEL, trace silt	235
20	S-4	25 29 14 15	24	12			Brown c-f SAND and c-f GRAVEL, trace silt	230
25	S-5	11 7 6 10	24	15			Brown f SAND, little silt	225
30	S-6	11 19 13 16	24	13		GLACIAL TILL	Tan f-c SAND and c-f GRAVEL, little silt	220
35	S-7	10 11 12 11	24	10			Gray c-f GRAVEL, some f-c sand, trace silt	215
40	S-8	13 50 50	12	3			Gray c-f GRAVEL, some f-c gravel, trace silt	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 40ft Rock: 10ft	NOTES: Encountered 0.8-inches of bituminous concrete pavement with no discernable subbase. Telescoped through 4-inch casing with 3-inch casing at 14-feet below ground surface; and added drilling mud to drilling water.	Sheet 1 of 2
No. of Soil Samples: 8 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-13	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 889930.3	
Start Date: 8-22-19	Route No.: 12	Easting: 1233808.3	
Finish Date: 8-22-19	Bridge No.: NA	Surface Elevation: 250.4	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ/3in HFJ	Sampler Type/Size: 2in SS	Core Barrel Type: NX2	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @11.1 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40						BEDROCK		210
45	C-1		60	51	56		Gray medium grained, medium bedded, moderately fractured, slightly weathered Gneiss Core Times (min/ft): 7.5, 4.0, 5.0, 4.5, 6.5	205
50	C-2		60	33	0		Gray medium grained, medium bedded, intensely fractured, moderately weathered Gneiss Core Times (min/ft): 3.0, 3.5, 4.5, 5.0, 5.5	200
55							END OF BORING 50ft	195
60								190
65								185
70								180
75								175
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 40ft Rock: 10ft	NOTES: Encountered 0.8-inches of bituminous concrete pavement with no discernable subbase. Telescoped through 4-inch casing with 3-inch casing at 14-feet below ground surface; and added drilling mud to drilling water.	Sheet 2 of 2
No. of Soil Samples: 8 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-14	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 889953.2	
Start Date: 8-15-19	Route No.: 12	Easting: 1233911.2	
Finish Date: 8-16-19	Bridge No.: NA	Surface Elevation: 251.9	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ/3in HFJ	Sampler Type/Size: 2in SS	Core Barrel Type: NX2	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @ 15.8 after 0 hours, @10.7 after 24+ hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						PAVEMENT STRUCTURE/ MISC. FILL		250
5	S-1	14 16 12 13	24	11		SANDY GRAVEL	Brown c-f SAND and c-f GRAVEL, trace silt with cobbles	245
10	S-2	9 12 7 6	24	11			Bottom (6-inch): Brown f-c SAND, some f gravel, trace silt Top (5-inch): c-f GRAVEL, some c-f sand, trace silt with cobbles	240
15	S-3	11 8 9 10	24	7			Gray c-f GRAVEL, little c-f sand, trace silt with cobbles	235
20	S-4	29 17 10 17	24	7			Brown c-f SAND and c-f GRAVEL, trace silt with cobbles	230
25	S-5	14 11 24 11	24	6			Brown c-f GRAVEL and c-f SAND, trace silt with cobbles	225
30	S-6	19 31 37 34	24	16		GLACIAL TILL	Brown c-f GRAVEL and c-f SAND, trace silt with cobbbles	220
35	S-7	22 42 33 35	24	12			Top (2-inch) Gray c GRAVEL, trace c-f sand, trace silt with cobbels Bottom (10-inch) Brown f-c SAND and c-f GRAVEL, trace silt	215
40	S-8	11 14 38 50	21	15			Tan f SAND, little f gravel, little silt	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 43.2ft Rock: 9.5ft	NOTES: Encountered 4 inches of bituminous concrete pavement with no discernable subbase. Added drilling mud to drilling water to advance casing. Telescoped through 4-inch casing with 3-inch casing at 13' below ground surface.	Sheet 1 of 2
No. of Soil Samples: 9 No. of Core Runs: 2		SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD013 (Boring Logs 8).dgn

SIGNATURE/ BLOCK: OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE: PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: BORING LOGS

PROJECT NO. 115-121
DRAWING NO. SD-013
SHEET NO. 03.13

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-14	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 889953.2	
Start Date: 8-15-19	Route No.: 12	Easting: 1233911.2	
Finish Date: 8-16-19	Bridge No.: NA	Surface Elevation: 251.9	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ/3in HFJ	Sampler Type/Size: 2in SS	Core Barrel Type: NX2	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @ 15.8 after 0 hours, @10.7 after 24+ hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40						GLACIAL TILL (con't)		210
	S-9	50	2	1		BEDROCK	Gray c-f GRAVEL, little c-f sand, trace silt	
45	C-1		54	41	20		Gray medium grained, medium bedded, intensely fractured, moderately weathered Gneiss Core Times (min/ft): 2.0, 3.5, 3.0, 3.5, 5.5	205
50	C-2		60	60	70		Gray medium grained, medium bedded, highly fractured, slightly weathered Gneiss Core Times (min/ft): 2.5, 3.0, 2.5, 2.5, 4.0	200
55							END OF BORING 52.7ft	195
60								190
65								185
70								180
75								175
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 43.2ft Rock: 9.5ft No. of Soil Samples: 9 No. of Core Runs: 2	NOTES: Encountered 4 inches of bituminous concrete pavement with no discernable subbase. Added drilling mud to drilling water to advance casing. Telescoped through 4-inch casing with 3-inch casing at 13' below ground surface.	Sheet 2 of 2 SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-15	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 889989.6	
Start Date: 8-15-19	Route No.: 12	Easting: 1234021	
Finish Date: 8-15-19	Bridge No.: NA	Surface Elevation: 254.9	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ/3in HFJ	Sampler Type/Size: 2in SS	Core Barrel Type: NX2	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @12.7 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						TOPSOIL MISC. FILL		
5	S-1	20 8 6 10	24	9		GRAVELLY SAND	Brown f-c SAND, trace silt with cobbles	250
10	S-2	18 11 8 8	24	11			Brown c-f SAND and f-c GRAVEL, trace silt with cobbles	245
15	S-3	14 22 16 10	24	8			Brown c-f SAND and c-f GRAVEL, trace silt with cobbles	240
20	S-4	38 46 30 22	24	12		COBBLE GRAVELLY SAND	Top (8-inch): Gray c-f GRAVEL, little c-f sand, trace silt with cobbles Bottom (4-inch): Brown c-f GRAVEL and c-f SAND, trace silt with cobbles	235
25	S-5	16 11 14 29	24	15			Gray f-c SAND, some c-f GRAVEL, trace silt	230
30	S-6	17 27 44 50	22	13		GLACIAL TILL	Tan f-c SAND and c-f GRAVEL, little silt	225
35	S-7	40 35 30 21	24	9			Tan f-c SAND and c-f GRAVEL, little silt with cobbles	220
40	S-8	50	1	1		WEATHERED BEDROCK	Gray f-c GRAVEL and c-f SAND, trace silt	215

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 38.1ft Rock: 10ft No. of Soil Samples: 8 No. of Core Runs: 2	NOTES: Encountered 6 inches of topsoil. Added drilling mud to drilling water to advance the casing. Telescoped through the 4-inch casing with 3-inch casing at 13-feet below ground surface.	Sheet 1 of 2 SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-15	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 889989.6	
Start Date: 8-15-19	Route No.: 12	Easting: 1234021	
Finish Date: 8-15-19	Bridge No.: NA	Surface Elevation: 254.9	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ/3in HFJ	Sampler Type/Size: 2in SS	Core Barrel Type: NX2	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @12.7 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40	C-1		60	11	0	WEATHERED BEDROCK (con't)	Gray Weathered Bedrock Core Times (min/ft): 3.0, 3.5, 3.5, 3.5, 3.0	210
45	C-2		60	10	0		Gray Weathered Bedrock Core Times (min/ft): 2.5, 2.5, 2.5, 2.0, 3.5	
50							END OF BORING 48.1ft	205
55								200
60								195
65								190
70								185
75								180
80								175

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 38.1ft Rock: 10ft No. of Soil Samples: 8 No. of Core Runs: 2	NOTES: Encountered 6 inches of topsoil. Added drilling mud to drilling water to advance the casing. Telescoped through the 4-inch casing with 3-inch casing at 13-feet below ground surface.	Sheet 2 of 2 SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD014 (Boring Logs 9).dgn

SIGNATURE/BLOCK: OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE: PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: BORING LOGS

PROJECT NO. 115-121
DRAWING NO. SD-014
SHEET NO. 03.14

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-16	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 890029.1	
Start Date: 8-14-19	Route No.: 12	Easting: 1234129.4	
Finish Date: 8-14-19	Bridge No.: NA	Surface Elevation: 257.7	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 3in HFJ/4in HFJ	Sampler Type/Size: 2in SS	Core Barrel Type: NX2	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @14.3 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						PAVEMENT STRUCTURE/ MISC. FILL		255
5	S-1	15 11 15 13	24	13		GRAVELLY SAND	Brown c-f SAND and f-c GRAVEL, trace silt with cobbles	250
10	S-2	19 8 7 14	24	9			Brown c-f SAND and c-f GRAVEL, trace silt with cobbles	245
15	S-3	16 12 13 11	24	12			Brown c-f SAND and f-c GRAVEL, trace Silt with cobbles	240
20	S-4	24 11 10 10	24	8			Brown c-f SAND and f-c GRAVEL, trace silt with cobbles	235
25	S-5	11 14 20 14	24	9			Brown c-f SAND and c-f GRAVEL, trace silt with cobbles	230
30	S-6	30 36 34 29	24	9		GLACIAL TILL	Brown f SAND, some f-c gravel, trace silt with cobbles	225
35	S-7	27 28 27 25	24	14			Brown f SAND and c-f GRAVEL, little silt	220
40	S-8	18	0	0.5		BEDROCK	Weathered bedrock	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 38.5ft Rock: 10ft	NOTES: Pavement structure consists of 6-inch bituminous concrete pavement with no discernable subbase. Added drilling mud to drilling water. Started drilling with 3-inch casing. At 19-feet below ground surface, removed the 3-inch casing; inserted 13-feet of 4-inch casing and telescoped through with 3-inch casing.	Sheet 1 of 2
No. of Soil Samples: 8 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-16	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 890029.1	
Start Date: 8-14-19	Route No.: 12	Easting: 1234129.4	
Finish Date: 8-14-19	Bridge No.: NA	Surface Elevation: 257.7	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 3in HFJ/4in HFJ	Sampler Type/Size: 2in SS	Core Barrel Type: NX2	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @14.3 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40	C-1		60	26	16	BEDROCK (cont)	Gray medium grained, medium bedded, intensely fractured, moderately weathered Gneiss Core Times (min/ft): 4.0, 4.0, 2.0, 3.0, 2.0	215
45	C-2		60	54	66		Gray medium grained, medium bedded, moderately fractured, moderately weathered Gneiss Core Times (min/ft): 3.0, 3.5, 4.0, 4.0, 4.5	210
50							END OF BORING 48.5ft	205
55								200
60								195
65								190
70								185
75								180
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 38.5ft Rock: 10ft	NOTES: Pavement structure consists of 6-inch bituminous concrete pavement with no discernable subbase. Added drilling mud to drilling water. Started drilling with 3-inch casing. At 19-feet below ground surface, removed the 3-inch casing; inserted 13-feet of 4-inch casing and telescoped through with 3-inch casing.	Sheet 2 of 2
No. of Soil Samples: 8 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-17	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 889994	
Start Date: 8-13-19	Route No.: 12	Easting: 1234159.8	
Finish Date: 8-13-19	Bridge No.: NA	Surface Elevation: 257.6	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 3in HFJ	Sampler Type/Size: 2in SS	Core Barrel Type: NX2	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @13 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						PAVEMENT STRUCTURE/ MISC. FILL		255
5	S-1	15 10 7 7	24	10		GRAVELLY SAND	Brown c-f SAND, some f-c gravel, trace silt with cobbles	250
10	S-2	27 16 15 17	24	11			Brown c-f SAND, some c-f gravel, trace silt with coobles	245
15	S-3	17 17 16 17	24	10			Brown c-f SAND, some c-f gravel, trace silt with cobbles	240
20	S-4	6 7 9 10	24	8			Brown c-f SAND, some c-f gravel, trace silt	235
25	S-5	23 29 30 27	24	8		GLACIAL TILL	Brown c-f SAND and c-f GRAVEL, trace silt with cobbles	230
30	S-6	30 55 44 56	24	12			Bottom (10-inch) Brown f-c SAND and c-f GRAVEL, trace silt Top (2-inch) Gray f-c GRAVEL	225
35	S-7	9 7 10 12	24	14			Brown f SAND, some c-f gravel, little silt	220
40	S-8	48 50	8	6			Brown c-f SAND, some f-c gravel, trace silt	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 44ft Rock: 8.5ft	NOTES: Pavement structure consists of 6-inch bituminous concrete pavement with no discernable subbase. Added drilling mud to drilling water to advance the casing. Made two attempts to remove rock core C-2 from the hole.	Sheet 1 of 2
No. of Soil Samples: 8 No. of Core Runs: 2		SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD015 (Boring Logs 10).dgn

SIGNATURE/BLOCK: OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE: PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM
DRAWING TITLE: BORING LOGS

PROJECT NO. 115-121
DRAWING NO. SD-015
SHEET NO. 03.15

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-17	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 889994	
Start Date: 8-13-19	Route No.: 12	Easting: 1234159.8	
Finish Date: 8-13-19	Bridge No.: NA	Surface Elevation: 257.6	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 3in HFJ	Sampler Type/Size: 2in SS	Core Barrel Type: NX2	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @13 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40						GLACIAL TILL *(con't)*		215
45	C-1		60	32	53	BEDROCK	Gray medium grained, medium bedded, moderately fractured, slightly weathered Gneiss Core Times (min/ft): 1.0, 3.5, 4.5, 3.0, 4.0	210
50	C-2		42	48	100		Gray medium grained, medium bedded, moderately fractured, slightly weathered Gneiss Core Times (min/ft): 3.5, 3.5, 3.5, 2.5	205
55							END OF BORING 52.5ft	200
60								195
65								190
70								185
75								180
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 44ft Rock: 8.5ft No. of Soil Samples: 8 No. of Core Runs: 2	NOTES: Pavement structure consists of 6-inch bituminous concrete pavement with no discernable subbase. Added drilling mud to drilling water to advance the casing. Made two attempts to remove rock core C-2 from the hole.	Sheet 2 of 2 SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-18	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 889863.5	
Start Date: 8-20-19	Route No.: 12	Easting: 1233922.4	
Finish Date: 8-22-19	Bridge No.: NA	Surface Elevation: 251.3	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ/3in HFJ	Sampler Type/Size: 2in SS	Core Barrel Type: NX2	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @3.7 after 0 hours, @11 after 24+ hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						TOPSOIL		250
						MISC. FILL		
5	S-1	13 9 10 13	24	12		GRAVELLY SAND	Brown c-f SAND, some c-f gravel, trace silt with cobbles	245
10	S-2	7 5 6 5	24	10			Brown c-f SAND, some f-c gravel, trace silt with cobbles	240
15	S-3	8 5 3 10	24	8			Brown f- c SAND, little f-c gravel, little silt with cobbles	235
20	S-4	11 7 7 8	24	7			Brown c-f SAND, some f-c gravel, trace silt with cobbles	230
25	S-5	6 6 6 7	24	0			Brown c-f SAND, some f-c gravel, trace silt	225
						GLACIAL TILL		
30	S-6	8 21 19 24	24	13			Tan f SAND, some c-f gravel, trace silt	220
35	S-7	35 56 58	16	10			Brown f-c SAND and c-f GRAVEL, trace silt	215
40	S-8	14 8 10 14	24	8			Tan f SAND and c-f GRAVEL, little silt	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 44ft Rock: 10ft No. of Soil Samples: 9 No. of Core Runs: 2	NOTES: Encountered 6 inches of topsoil. Added drilling mud to drilling water to advance the casing. Telescoped through the 4-inch casing with 3-inch at 13-feet below ground surface. Placed the bottom of the well at 30' below ground surface. backfilled with FilPro sand and gravel and Bentonite Plug (Sodium Bentonite).	Sheet 1 of 2 SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-18	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 889863.5	
Start Date: 8-20-19	Route No.: 12	Easting: 1233922.4	
Finish Date: 8-22-19	Bridge No.: NA	Surface Elevation: 251.3	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ/3in HFJ	Sampler Type/Size: 2in SS	Core Barrel Type: NX2	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @3.7 after 0 hours, @11 after 24+ hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40						GLACIAL TILL *(con't)*		210
	S-9	50	2	0			Gray weathered bedrock	
45	C-1		60	60	90	BEDROCK	Gray medium grained, medium bedded, slightly fractured, slightly weathered Gneiss Core Times (min/ft): 3.5, 3.0, 3.5, 3.5, 5.0	205
50	C-2		60	60	74		Gray medium grained, medium bedded, moderately fractured, slightly weathered Gneiss Core Times (min/ft): 4.0, 5.0, 3.0, 3.0, 3.0	200
55							END OF BORING 54ft	195
60								190
65								185
70								180
75								175
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 44ft Rock: 10ft No. of Soil Samples: 9 No. of Core Runs: 2	NOTES: Encountered 6 inches of topsoil. Added drilling mud to drilling water to advance the casing. Telescoped through the 4-inch casing with 3-inch at 13-feet below ground surface. Placed the bottom of the well at 30' below ground surface. backfilled with FilPro sand and gravel and Bentonite Plug (Sodium Bentonite).	Sheet 2 of 2 SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD016 (Boring Logs 11).dgn

SIGNATURE/BLOCK:
OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE:
PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: BORING LOGS

PROJECT NO. 115-121
DRAWING NO. SD-016
SHEET NO. 03.16

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-19	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 889840.7	
Start Date: 8-20-19	Route No.: 12	Easting: 1233849	
Finish Date: 8-20-19	Bridge No.: NA	Surface Elevation: 250.4	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ/3in HF	Sampler Type/Size: 2in SS	Core Barrel Type: -	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @12.1 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						PAVAMENT STRUCTURE/ MISC. FILL		250
5	S-1	10 10 9 11	24	12		GRAVELLY SAND	Brown c-f SAND, some c-f gravel, trace silt with cobbles	245
10	S-2	10 18 9 6	24	11			Brown c-f SAND and c-f GRAVEL, trace silt	240
15	S-3	16 11 5 2	24	11			Brown f SAND, some c-f gravel, little silt with cobbles	235
20	S-4	21 10 10 8	24	8			Brown c-f SAND and c-f GRAVEL, trace silt with cobbles	230
25	S-5	17 16 9 11	24	9			Gray c-f GRAVEL, little c-f sand, trace silt with cobbles	225
30	S-6	13 33 19 20	24	9		GLACIAL TILL	Brown f SAND and c-f GRAVEL, little silt	220
35	S-7	9 14 17 22	24	11			Brown f SAND and c-f GRAVEL, little silt with cobbles	215
40	S-8	8 8 13 30	24	8			Gray c-f GRAVEL, some f sand, little silt	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 48.5ft Rock: 0ft	NOTES: Encountered 0.8-inches of bituminous concrete pavement with no discernable subbase. Added drilling mud to drilling water to advance the casing. Telescoped through 4-inch casing with 3-inch casing at 13-feet below ground surface.	Sheet 1 of 2
No. of Soil Samples: 10 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: B-19	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 889840.7	
Start Date: 8-20-19	Route No.: 12	Easting: 1233849	
Finish Date: 8-20-19	Bridge No.: NA	Surface Elevation: 250.4	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ/3in HF	Sampler Type/Size: 2in SS	Core Barrel Type: -	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @12.1 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40						GLACIAL TILL *(cont)*		210
45	S-9	13 27 50	15	6			Gray c-f GRAVEL, little c-f sand, trace silt	205
50	S-10	50	6	4			Gray c-f GRAVEL, little c-f sand, trace silt END OF BORING 48.5ft	200
55								195
60								190
65								185
70								180
75								175
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 48.5ft Rock: 0ft	NOTES: Encountered 0.8-inches of bituminous concrete pavement with no discernable subbase. Added drilling mud to drilling water to advance the casing. Telescoped through 4-inch casing with 3-inch casing at 13-feet below ground surface.	Sheet 2 of 2
No. of Soil Samples: 10 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: R-1	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889501	
Start Date: 9-15-17	Route No.: 12	Easting: 1234420	
Finish Date: 9-15-17	Bridge No.: NA	Surface Elevation: 252.9	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type:	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @11 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	5 8 17 60	24	15		TOPSOIL GRAVELLY SAND	Top (6-inch): Topsoil Bottom (9-inch): Brown C-F SAND AND F-C GRAVEL, trace silt	250
5	S-2	11 16 17 18	24	13			Brown C-F SAND AND F-C GRAVEL, trace silt	245
10	S-3	18 24 18 20	24	13		GLACIAL TILL	Top (6 inch): Gray C-F SAND AND C-F GRAVEL, trace silt with cobbles Bottom (7-inch): Brown C-F SAND AND C-F GRAVEL, trace silt	240
15	S-4	16 17 25 77	24	16			Tan F-C SAND, some f-c gravel, trace silt with cobbles END OF BORING 16ft	235
20								230
25								225
30								220
35								215
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 16ft Rock: 0ft	NOTES:	Sheet 1 of 1
No. of Soil Samples: 4 No. of Core Runs: 0		SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD017 (Boring Logs 12).dgn

SIGNATURE/BLOCK: OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE: PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: BORING LOGS

PROJECT NO. 115-121
DRAWING NO. SD-017
SHEET NO. 03.17

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: R-2	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889820	
Start Date: 8-30-17	Route No.: 12	Easting: 1234113	
Finish Date: 8-30-17	Bridge No.: NA	Surface Elevation: 251.6	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 3in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type:	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @8.6 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	17 11 7 5	24	8		PAVEMENT STRUCTURE/ MISC. FILL	Brown C-F SAND AND F-C GRAVEL, trace silt	250
5	S-2	19 7 5 6	24	13		GRAVELLY SAND	Brown F-C SAND, little f-c gravel, trace silt with cobbles	245
10	S-3	14 12 13 10	24	14			Brown C-F SAND AND C-F GRAVEL, trace silt	240
15	S-4	16 9 9 10	24	14			Brown C-F SAND AND C-F GRAVEL, trace silt with cobbles	235
							END OF BORING 16ft	
20								230
25								225
30								220
35								215
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 16ft Rock: 0ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement.	Sheet 1 of 1
No. of Soil Samples: 4 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: R-3	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889945	
Start Date: 8-30-17	Route No.: 12	Easting: 1234066	
Finish Date: 8-30-17	Bridge No.: NA	Surface Elevation: 254.8	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 3in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type:	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @Dry after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	9 11 15 14	24	17		PAVEMENT STRUCTURE/ MISC. FILL	Brown C-F SAND AND F-C GRAVEL, trace silt	
5	S-2	14 11 13 16	24	17		GRAVELLY SAND	Brown C-F SAND AND F-C GRAVEL, trace silt	250
10	S-3	4 4 6 9	24	13			Brown C-F SAND AND F-C GRAVEL, trace silt	245
15	S-4	9 10 10 8	24	8			Brown C-F SAND AND C-F GRAVEL, trace silt	240
							END OF BORING 16ft	
20								235
25								230
30								225
35								220
40								215

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 16ft Rock: 0ft	NOTES: Pavement structure consists of 2" of bituminous concrete pavement.	Sheet 1 of 1
No. of Soil Samples: 4 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: R-4	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889770	
Start Date: 8-30-17	Route No.: 12	Easting: 1234075	
Finish Date: 8-30-17	Bridge No.: NA	Surface Elevation: 251.0	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 3in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type:	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @9.7 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	13 16 17 13	24	18		PAVEMENT STRUCTURE/ MISC. FILL	Brown C-F SAND AND C-F GRAVEL, trace silt	250
5	S-2	11 10 6 3	24	9		GRAVELLY SAND	Brown C-F SAND AND C-F GRAVEL, trace silt	245
10	S-3	17 13 14 14	24	8			Brown C-F SAND AND C-F GAVEL, trace silt with cobbles	240
15	S-4	27 16 13 15	24	0			No Recovery	235
							END OF BORING 16ft	
20								230
25								225
30								220
35								215
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 16ft Rock: 0ft	NOTES: Pavement structure consists of 6" of bituminous conceret pavement.	Sheet 1 of 1
No. of Soil Samples: 4 No. of Core Runs: 0		SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD018 (Boring Logs 13).dgn

SIGNATURE/ BLOCK:
OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE:
PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE:
BORING LOGS

PROJECT NO. 115-121
DRAWING NO. SD-018
SHEET NO. 03.18

Connecticut DOT Boring Report

Driller: Chris Knight		Hole No.: R-5	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889648	
Start Date: 9-21-17	Route No.: 12	Easting: 1233991	
Finish Date: 9-21-17	Bridge No.: NA	Surface Elevation: 249.2	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 3in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type:	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @12 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						PAVEMENT STRUCTURE/ MISC. FILL		
	S-1	14 23 25 20	24	18			Brown C-F SAND, some c-f gravel, trace silt	
5	S-2	11 14 13 12	24	15		GRAVELLY SAND	Brown C-F SAND, some f-c Gravel, trace silt	245
10	S-3	4 6 12 10	24	12			Brown C-F SAND, trace silt	240
15	S-4	9 17 17 18	24	12			Tan F-C SAND, some c-f gravel, trace silt	235
							END OF BORING 16ft	
20								230
25								225
30								220
35								215
40								210

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 16ft Rock: 0ft	NOTES: Pavement structure consists of 8" of bituminous concrete pavement.	Sheet 1 of 1
No. of Soil Samples: 4 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Scott McGregor		Hole No.: R-6	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Ghatee	Project No.: 0115-0121	Northing: 889913.3	
Start Date: 8-22-19	Route No.: 12	Easting: 1233756.2	
Finish Date: 8-22-19	Bridge No.: NA	Surface Elevation: 247.6	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 3in HFJ	Sampler Type/Size: 2in SS	Core Barrel Type: -	
Hammer Wt.: - Fall: in.	Hammer Wt.: 140 lb Fall: 30in.		
Groundwater Observations: @4.1 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						PAVEMENT STRUCTURE/ MISC. FILL		
								245
5	S-1	12 21 10 8	24	16		GRAVELLY SAND	Brown c-f SAND, trace f gravel, trace silt	
								240
10	S-2	11 4 4 5	24	11			Brown c-f SAND, trace f gravel, trace silt	
								235
15	S-3	4 4 6 7	24	10			Brown c-f SAND and c-f GRAVEL, trace silt	
							END OF BORING 16ft	230
20								
								225
25								
								220
30								
								215
35								
								210
40								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 16ft Rock: 0ft	NOTES: Encountered 0.8-inches of bituminous concrete pavement with no discernable subbase.	Sheet 1 of 1
No. of Soil Samples: 3 No. of Core Runs: 0		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: RW-1	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 890014	
Start Date: 9-12-17	Route No.: 12	Easting: 1234201	
Finish Date: 9-13-17	Bridge No.: NA	Surface Elevation: 259.5	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @14 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0						PAVEMENT STRUCTURE/ MISC. FILL		
	S-1	3 5 8 11	24	17			Brown C-F SAND, some f-c gravel, trace silt	
5	S-2	10 13 17 21	24	14		GRAVELLY SAND	Brown C-F SAND AND C-F GRAVEL, trace silt	255
10	S-3	11 14 17 12	24	13			Brown C-F SAND, some c-f Gravel, trace silt	250
15	S-4	15 10 10 10	24	8			Brown C-F SAND AND C-F GRAVEL, tarce silt	245
20	S-5	30 25 22 20	24	12		GLACIAL TILL	Brown F-C GRAVEL, some c-f sand, trace silt	240
25	S-6	20 28 30 30	24	15			Tan F-C SAND, some c-f Gravel, trace silt	235
30	S-7	20 20 52 90	24	6			Gray C-F GRAVEL, some f-c sand, trace silt	230
35	S-8	24 90	9	3			Gary C-F GRAVEL, some c-f sand, trace silt	225
40						BEDROCK		220

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 39ft Rock: 10ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement.	Sheet 1 of 2
No. of Soil Samples: 8 No. of Core Runs: 2		SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP/ME
CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD019 (Boring Logs 14).dgn

SIGNATURE/ BLOCK: OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE: PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: BORING LOGS

PROJECT NO. 115-121
DRAWING NO. SD-019
SHEET NO. 03.19

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: RW-1	
Inspector: Glenn L. Arzt	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 890014	
Start Date: 9-12-17	Route No.: 12	Easting: 1234201	
Finish Date: 9-13-17	Bridge No.: NA	Surface Elevation: 259.5	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @14 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40								
	C-1		60	32	15	BEDROCK *(con't)*	Gray medium grained, medium bedded, highly fractured, moderately weathered Gneiss Core Times (min/ft): 2.5, 2.5, 2.0, 3.5, 6.0	
45								215
	C-2		60	37	15		Gray medium grained, medium bedded, highly fractured, moderately weathered Gneiss Core Times (min/ft): 3.0, 3.0, 5.5, 3.5, 2.5	
50							END OF BORING 49ft	210
55								205
60								200
65								195
70								190
75								185
80								180

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 39ft Rock: 10ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement.	Sheet 2 of 2
No. of Soil Samples: 8 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: RW-2	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889888	
Start Date: 8-29-17	Route No.: 12	Easting: 1234144	
Finish Date: 8-29-17	Bridge No.: NA	Surface Elevation: 261.2	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @16 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
0	S-1	7 10 9 10	24	14		PAVEMENT STRUCTURE/ MICS: FILL	Light Brown C-F SAND AND C-F GRAVEL, trace silt	260
5	S-2	19 10 2 3	24	4			Gray C-F GRAVEL, trace c-f sand, trace silt	255
10	S-3	5 1 2 2	24	5		GRAVELLY SAND	Brown C-F GRAVEL, some c-f sand, trace silt	250
15	S-4	20 19 13 15	24	13			Brown C-F SAND, some f-c gravel, trace silt with cobbles	245
20	S-5	12 12 12 12	24	17			Brown C-F SAND AND C-F GRAVEL, trace silt with cobbles	240
25	S-6	16 14 16 10	24	14			Brown C-F SAND AND C-F GRAVEL, trace silt with cobbles	235
30	S-7	10 24 32 21	24	15		GLACIAL TILL	Tan F-C SAND, some f-c gravel, trace silt with cobbles	230
35	S-8	16 28 19 19	24	5			Gray C-F GRAVEL, trace c-f sand, trace silt	225
40	S-9	19 65 30	12	11			Tan F-C SAND, little f gravel, trace silt with	

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 42.75ft Rock: 10ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement.	Sheet 1 of 2
No. of Soil Samples: 9 No. of Core Runs: 2		SM-001-M REV. 1/02

Connecticut DOT Boring Report

Driller: Nick Kenny		Hole No.: RW-2	
Inspector: Sara Ghatee	Town: Putnam, Connecticut	Stat./Offset:	
Engineer: Sara Gahtee	Project No.: 0115-0121	Northing: 889888	
Start Date: 8-29-17	Route No.: 12	Easting: 1234144	
Finish Date: 8-29-17	Bridge No.: NA	Surface Elevation: 261.2	
Project Description: Putnam Maintenance Facility Renovation			
Casing Size/Type: 4in HFJ	Sampler Type/Size: 1.375in SS	Core Barrel Type: NX2	
Hammer Wt.: Fall: in.	Hammer Wt.: 140 Fall: 30in.		
Groundwater Observations: @16 after 0 hours			

Depth (ft)	Sample Type/No.	Blows on Sampler per 6 inches	Pen. (in.)	Rec. (in.)	RQD %	Generalized Strata Description	Material Description and Notes	Elevation (ft)
40							cobbles	
						BEDROCK		220
45	C-1		60	37	15		Gray medium grained, medium bedded, intensely fractured, moderately weathered Gneiss Core Times (min/ft): 4.0, 4.5, 4.5, 3.5,3.5	215
50	C-2		60	38	7		Gray medium grained, medium bedded, intensely fractured, moderately weathered Gneiss Core Times (min/ft): 2.5, 2.0, 2.5, 2.0, 1.5	210
55							END OF BORING 52.75ft	205
60								200
65								195
70								190
75								185
80								

Sample Type: S = Split Spoon C = Core UP = Undisturbed Piston V = Vane Shear Test
Proportions Used: Trace = 1 - 10%, Little = 10 - 20%, Some = 20 - 35%, And = 35 - 50%

Total Penetration in Earth: 42.75ft Rock: 10ft	NOTES: Pavement structure consists of 4" of bituminous concrete pavement.	Sheet 2 of 2
No. of Soil Samples: 9 No. of Core Runs: 2		SM-001-M REV. 1/02

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/5/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_SD_0115_0121_SD020 (Boring Logs 15).dgn

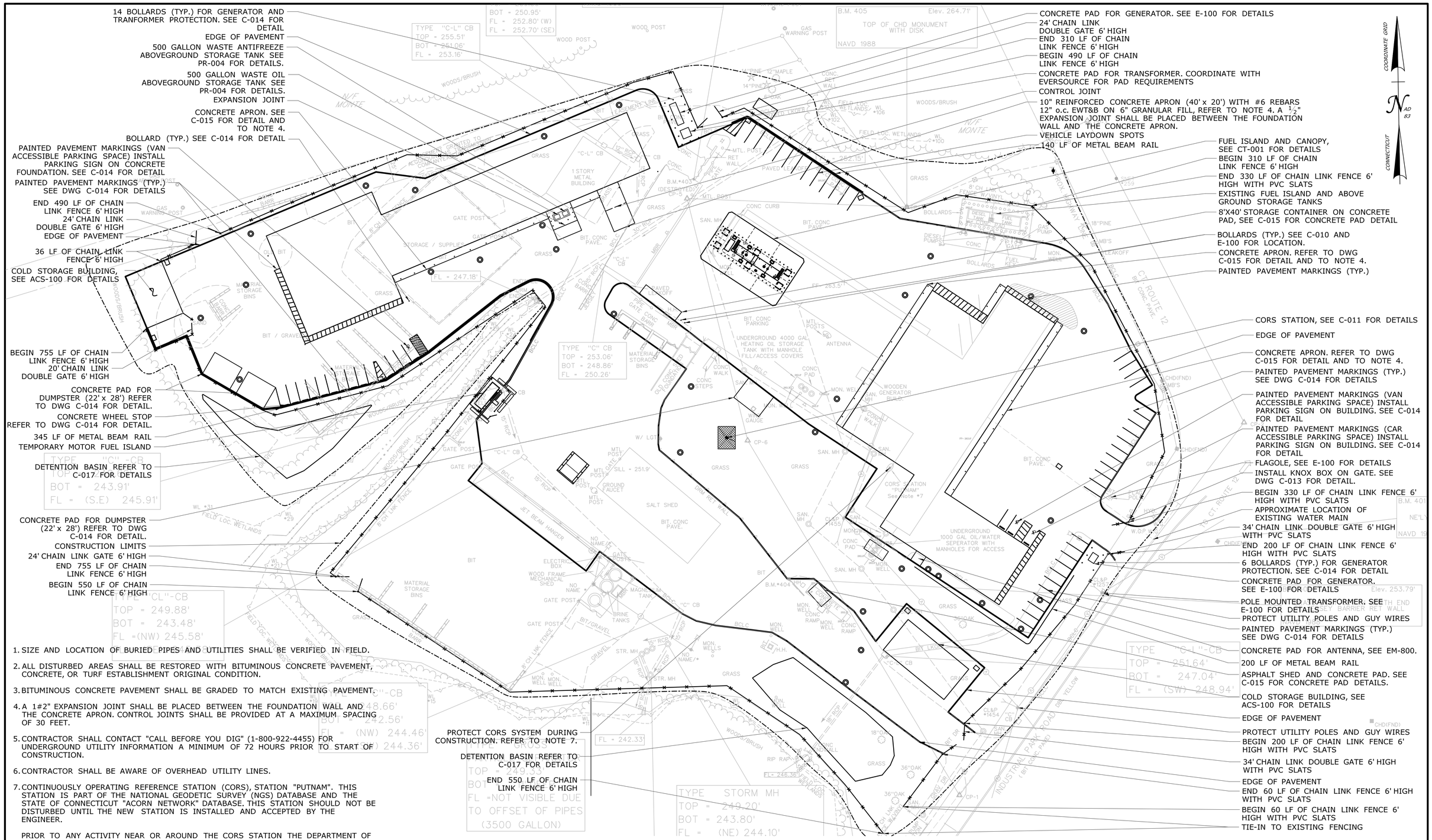
SIGNATURE/BLOCK:
OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE:
PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: BORING LOGS

PROJECT NO. 115-121
DRAWING NO. SD-020
SHEET NO. 03.20



1. SIZE AND LOCATION OF BURIED PIPES AND UTILITIES SHALL BE VERIFIED IN FIELD.
2. ALL DISTURBED AREAS SHALL BE RESTORED WITH BITUMINOUS CONCRETE PAVEMENT, CONCRETE, OR TURF ESTABLISHMENT ORIGINAL CONDITION.
3. BITUMINOUS CONCRETE PAVEMENT SHALL BE GRADED TO MATCH EXISTING PAVEMENT.
4. A 1#2" EXPANSION JOINT SHALL BE PLACED BETWEEN THE FOUNDATION WALL AND THE CONCRETE APRON. CONTROL JOINTS SHALL BE PROVIDED AT A MAXIMUM SPACING OF 30 FEET.
5. CONTRACTOR SHALL CONTACT "CALL BEFORE YOU DIG" (1-800-922-4455) FOR UNDERGROUND UTILITY INFORMATION A MINIMUM OF 72 HOURS PRIOR TO START OF CONSTRUCTION.
6. CONTRACTOR SHALL BE AWARE OF OVERHEAD UTILITY LINES.
7. CONTINUOUSLY OPERATING REFERENCE STATION (CORS), STATION "PUTNAM". THIS STATION IS PART OF THE NATIONAL GEODETIC SURVEY (NGS) DATABASE AND THE STATE OF CONNECTICUT "ACORN NETWORK" DATABASE. THIS STATION SHOULD NOT BE DISTURBED UNTIL THE NEW STATION IS INSTALLED AND ACCEPTED BY THE ENGINEER.

   PRIOR TO ANY ACTIVITY NEAR OR AROUND THE CORS STATION THE DEPARTMENT OF TRANSPORTATION MANAGER OF SURVEY OPERATIONS SHALL BE CONTACTED.

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/12/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME
SCALE IN FEET 0 40 80
SCALE 1"=40'

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

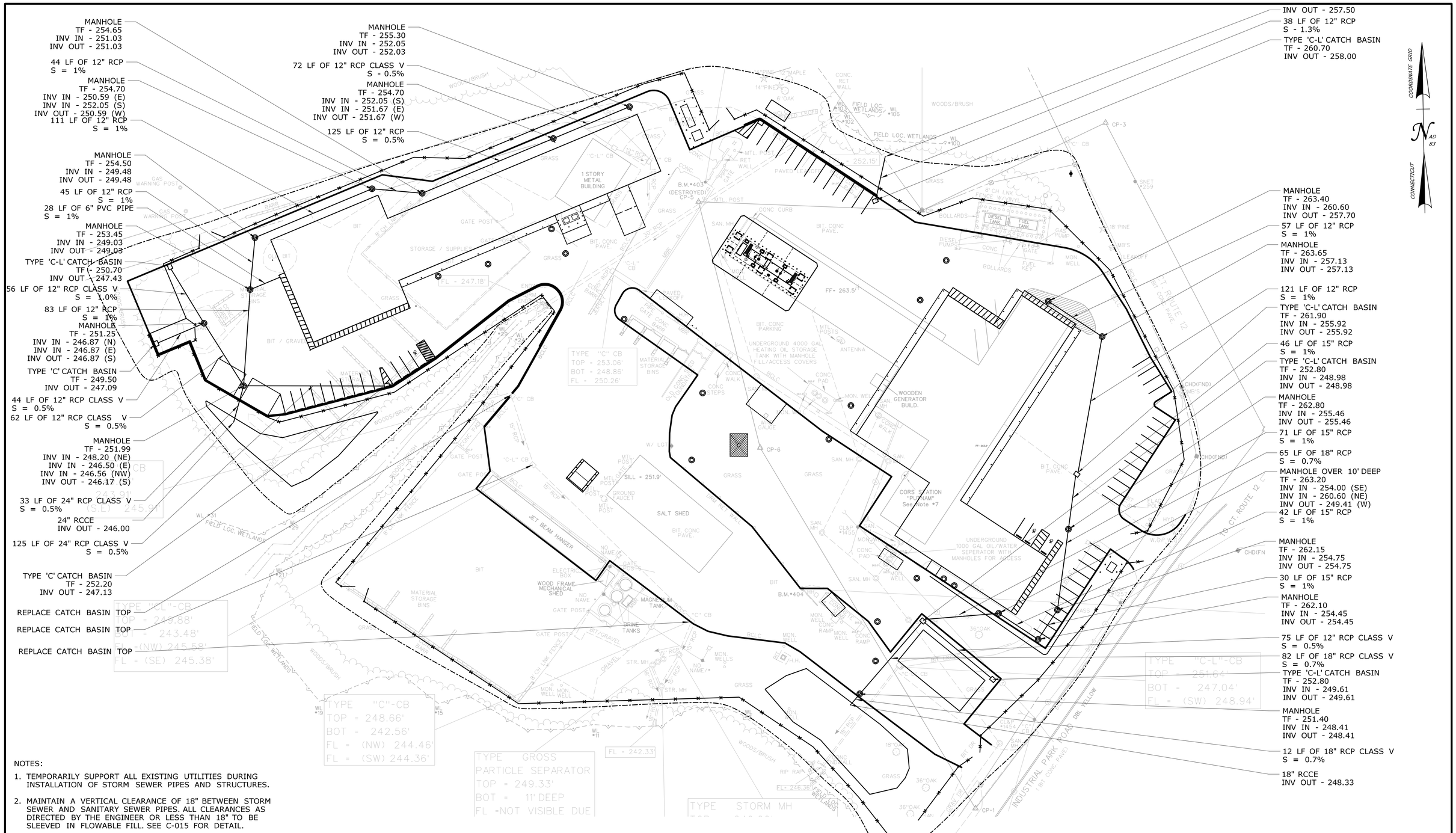
Filename: ...\FD_MSH_CIV_0115_0121_C005 (Site Plan).dgn

SIGNATURE/BLOCK: OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE: PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM
DRAWING TITLE: SITE PLAN

PROJECT NO. 115-121
DRAWING NO. C-005
SHEET NO. 04.05



NOTES:

1. TEMPORARILY SUPPORT ALL EXISTING UTILITIES DURING INSTALLATION OF STORM SEWER PIPES AND STRUCTURES.
2. MAINTAIN A VERTICAL CLEARANCE OF 18" BETWEEN STORM SEWER AND SANITARY SEWER PIPES. ALL CLEARANCES AS DIRECTED BY THE ENGINEER OR LESS THAN 18" TO BE SLEEVED IN FLOWABLE FILL. SEE C-015 FOR DETAIL.
3. REFER TO PLUMBING SUBSETS FOR PIPE CONTINUATIONS INTO BUILDING

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/27/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME
SCALE IN FEET 0 40 80
SCALE 1"=40'

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_CIV_0115_0121_C006 (Drainage Plan).dgn

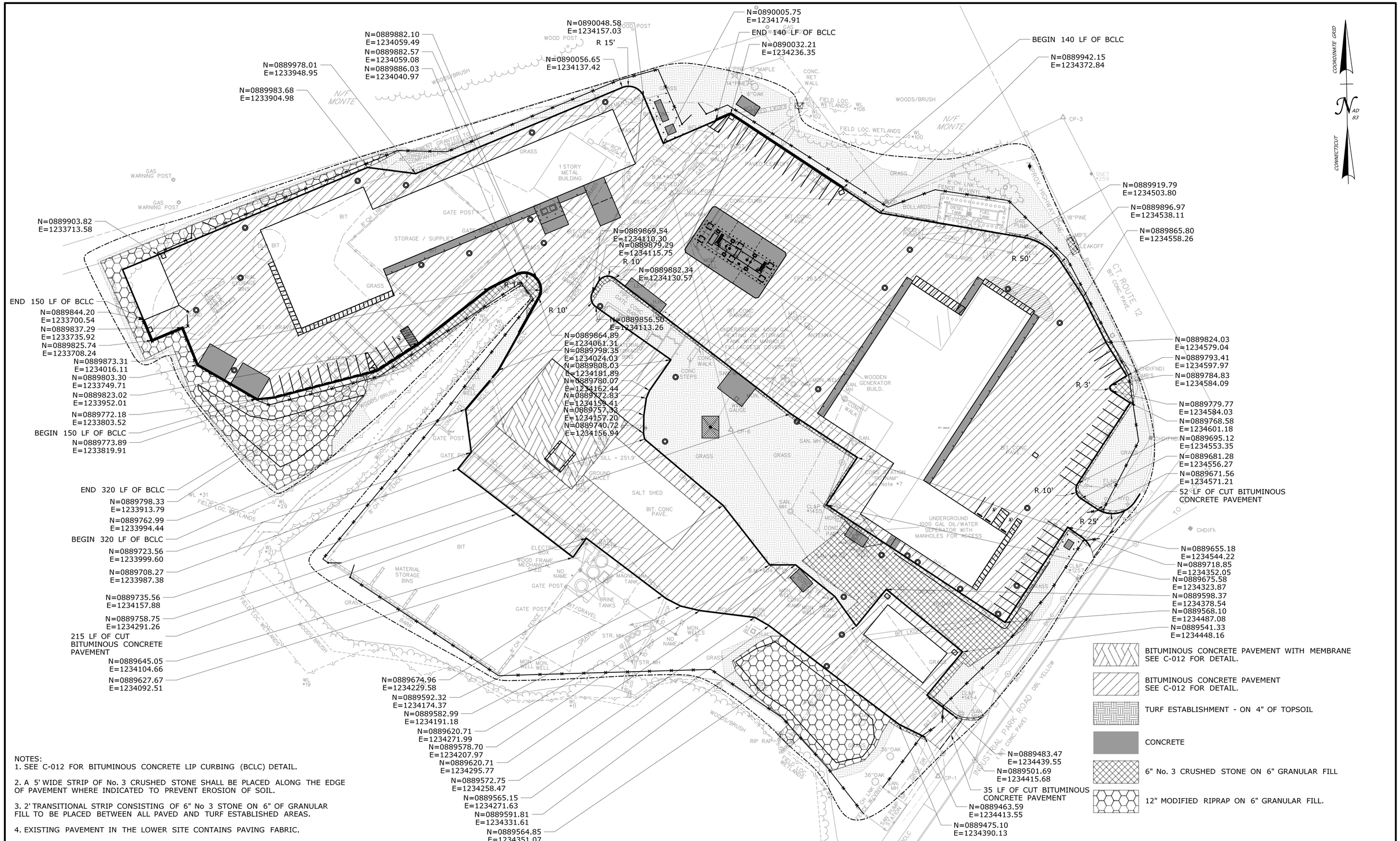
SIGNATURE/BLOCK: OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE: PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: DRAINAGE PLAN

PROJECT NO. 115-121
DRAWING NO. C-006
SHEET NO. 04.06



BITUMINOUS CONCRETE PAVEMENT WITH MEMBRANE
SEE C-012 FOR DETAIL.

BITUMINOUS CONCRETE PAVEMENT
SEE C-012 FOR DETAIL.

TURF ESTABLISHMENT - ON 4" OF TOPSOIL

CONCRETE

6" No. 3 CRUSHED STONE ON 6" GRANULAR FILL

12" MODIFIED RIPRAP ON 6" GRANULAR FILL.

NOTES:
1. SEE C-012 FOR BITUMINOUS CONCRETE LIP CURBING (BCLC) DETAIL.

2. A 5' WIDE STRIP OF No. 3 CRUSHED STONE SHALL BE PLACED ALONG THE EDGE OF PAVEMENT WHERE INDICATED TO PREVENT EROSION OF SOIL.

3. 2' TRANSITIONAL STRIP CONSISTING OF 6" No 3 STONE ON 6" OF GRANULAR FILL TO BE PLACED BETWEEN ALL PAVED AND TURF ESTABLISHED AREAS.

4. EXISTING PAVEMENT IN THE LOWER SITE CONTAINS PAVING FABRIC.

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/12/2020

DESIGNER/DRAFTER: **KP**

CHECKED BY: **ME**

SCALE IN FEET
0 40 80
SCALE 1"=40'

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_CIV_0115_0121_C008 (Pavement Plan).dgn

SIGNATURE/BLOCK:
OFFICE OF ENGINEERING

APPROVED BY:

PROJECT TITLE:
PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

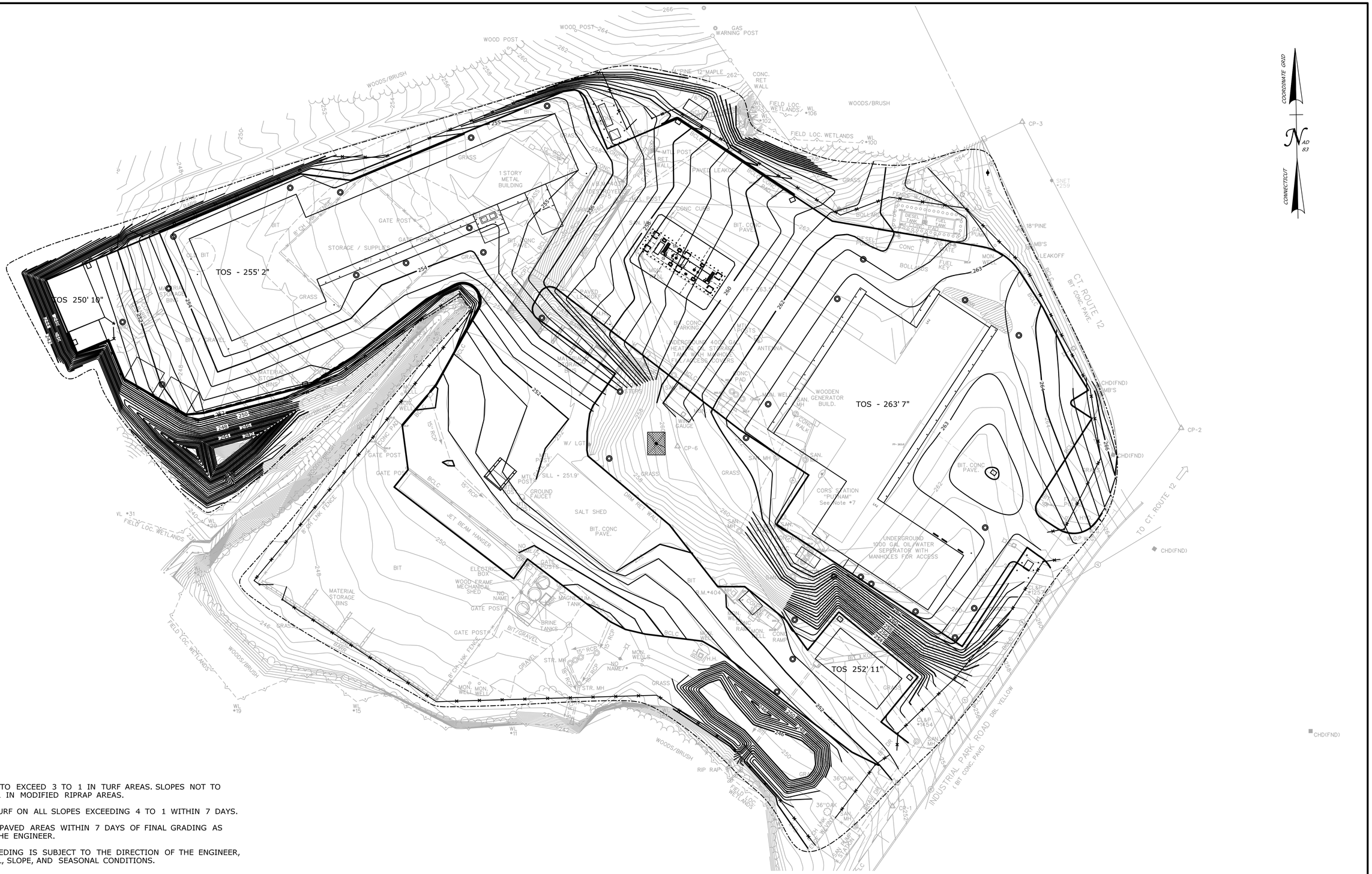
TOWN: **PUTNAM**

DRAWING TITLE:
PAVEMENT GEOMETRY AND SURFACE PLAN

PROJECT NO. **115-121**

DRAWING NO. **C-008**

SHEET NO. **04.08**



NOTES:

1. SLOPES NOT TO EXCEED 3 TO 1 IN TURF AREAS. SLOPES NOT TO EXCEED 2 TO 1 IN MODIFIED RIPRAP AREAS.

2. ESTABLISH TURF ON ALL SLOPES EXCEEDING 4 TO 1 WITHIN 7 DAYS.

3. SEED ALL UNPAVED AREAS WITHIN 7 DAYS OF FINAL GRADING AS DIRECTED BY THE ENGINEER.

4. ALL FINAL SEEDING IS SUBJECT TO THE DIRECTION OF THE ENGINEER, BASED ON SOIL, SLOPE, AND SEASONAL CONDITIONS.

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/12/2020

DESIGNER/DRAFTER: **KP**

CHECKED BY: **ME**

SCALE IN FEET 0 40 80

SCALE 1"=40'

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_CIV_0115_0121_C009 (Grading Plan).dgn

SIGNATURE/ BLOCK:

OFFICE OF ENGINEERING

APPROVED BY:

PROJECT TITLE:

PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

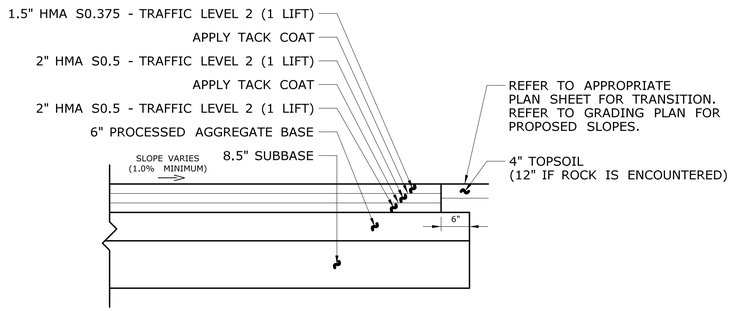
TOWN: **PUTNAM**

DRAWING TITLE: **GRADING PLAN**

PROJECT NO. **115-121**

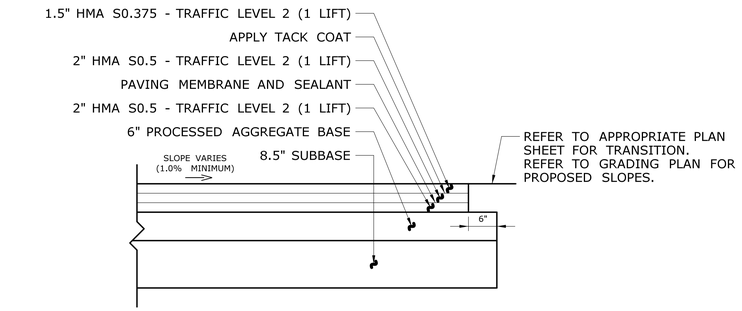
DRAWING NO. **C-009**

SHEET NO. **04.09**



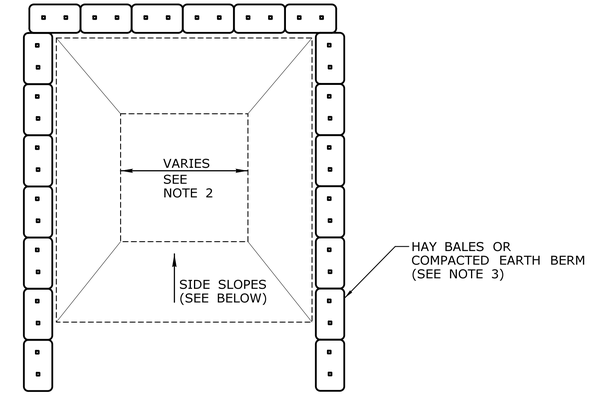
BITUMINOUS CONCRETE PAVEMENT

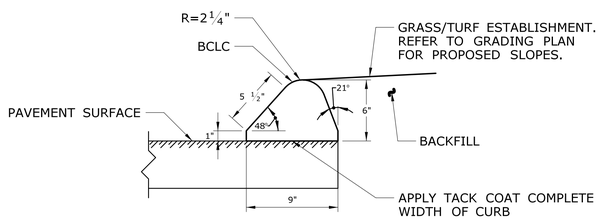
NOT TO SCALE



BITUMINOUS CONCRETE PAVEMENT - WITH MEMBRANE

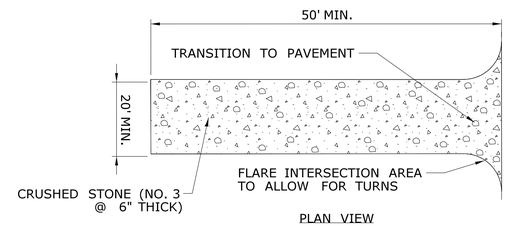
NOT TO SCALE



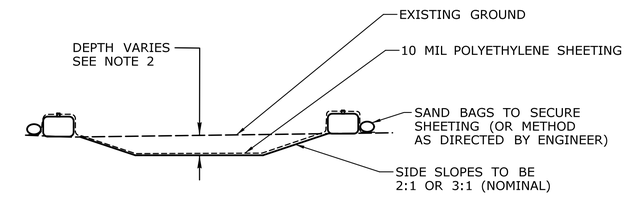


BITUMINOUS CONCRETE LIP CURBING

NOT TO SCALE

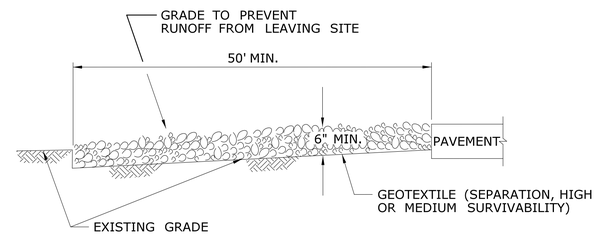


PLAN VIEW



CONCRETE WASHOUT AREA

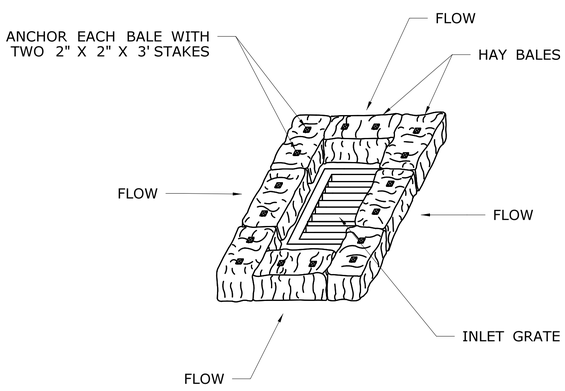
NOT TO SCALE
(SEE NOTE 2)



PROFILE

ANTI-TRACKING PAD

NOT TO SCALE



HAY BALE INSTALLATION AT CATCH BASIN

NOT TO SCALE

ANTI-TRACKING NOTES

1. LOCATION TO BE APPROVED BY ENGINEER.

2. STONE SIZE NO. 3 - 2 INCH STONE.

3. WASHING - WHEN NECESSARY, WHEELS SHALL BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTRANCE ONTO PUBLIC ROADWAY. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABILIZED WITH CRUSHED STONE WHICH DRAINS INTO AN APPROVED TRAP OR SEDIMENT BASIN. ALL SEDIMENT SHALL BE PREVENTED FROM ENTERING ANY STORM DRAIN, DITCH, OR WATERCOURSE USING APPROVED METHODS.

4. MAINTENANCE - THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC ROADWAYS. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND, AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.

5. ALL SEDIMENT SPILLED, DROPPED, WASHED, OR TRACKED ONTO PUBLIC ROADWAY MUST BE REMOVED IMMEDIATELY.

6. DRAINAGE - ENTRANCE MUST BE PROPERLY GRADED OR INCORPORATE A DRAINAGE SWALE TO PREVENT RUNOFF FROM LEAVING THE CONSTRUCTION SITE.

CONCRETE WASHOUT NOTES:

1. CONCRETE WASHOUT AREA(S) SHALL BE INSTALLED PRIOR TO CONCRETE PLACEMENT ON SITE. THE CONCRETE WASHOUT AREA SHALL BE ENTIRELY SELF-CONTAINED.

2. THE CONTRACTOR SHALL SUBMIT THE DESIGN, LOCATION AND SIZING OF THE CONCRETE WASHOUT AREA(S) WITH THE PROJECT'S EROSION AND SEDIMENTATION CONTROL PLAN AND SHALL BE APPROVED BY THE ENGINEER.

LOCATION: WASHOUT AREA(S) ARE TO BE LOCATED AT LEAST 50 FEET FROM ANY STREAM, WETLAND, STORM DRAINS, OR OTHER SENSITIVE RESOURCE. THE FLOOD CONTINGENCY PLAN MUST ADDRESS THE CONCRETE WASHOUT IF THE WASHOUT IS TO BE LOCATED WITHIN THE FLOODPLAIN.

SIZE: THE WASHOUT MUST HAVE SUFFICIENT VOLUME TO CONTAIN ALL LIQUID AND CONCRETE WASTE GENERATED BY WASHOUT OPERATIONS INCLUDING, BUT NOT LIMITED TO, OPERATIONS ASSOCIATED WITH GROUT AND MORTAR.

3. SURFACE DISCHARGE IS UNACCEPTABLE. THEREFORE, HAY BALES OR OTHER CONTROL MEASURES, AS APPROVED BY THE ENGINEER, SHOULD BE USED AROUND THE PERIMETER OF THE CONCRETE WASHOUT AREA FOR CONTAINMENT.

4. SIGNS SHOULD BE PLACED AT THE CONSTRUCTION ENTRANCE, AT THE CONCRETE AREA(S) AND ELSEWHERE AS NECESSARY TO CLEARLY INDICATE THE LOCATION OF THE CONCRETE WASHOUT TO OPERATORS OF CONCRETE TRUCKS AND PUMP RIGS. WASHOUT AREA(S) SHOULD BE FLAGGED WITH SAFETY FENCING OR OTHER APPROVED METHOD.

5. WASHOUT AREA(S) ARE TO BE INSPECTED AT LEAST ONCE A WEEK FOR STRUCTURAL INTEGRITY, ADEQUATE HOLDING CAPACITY AND CHECKED FOR LEAKS, TEARS, OR OVERFLOWS. (AS REQUIRED BY THE CONSTRUCTION SITE ENVIRONMENTAL INSPECTION REPORT) WASHOUT AREA(S) SHOULD BE CHECKED AFTER HEAVY RAINS.

6. HARDENED CONCRETE WASTE SHOULD BE REMOVED AND DISPOSED OF WHEN THE WASTE HAS ACCUMULATED TO HALF OF THE CONCRETE WASHOUT'S HEIGHT. THE WASTE CAN BE STORED AT AN UPLAND LOCATION, AS APPROVED BY THE ENGINEER. ALL CONCRETE WASTE SHALL BE DISPOSED OF IN A MANNER CONSISTENT WITH ALL APPLICABLE LAWS, REGULATIONS, AND GUIDELINES.

7. PAYMENT FOR THIS ITEM IS TO BE INCLUDED UNDER THE GENERAL COST OF THE WORK FOR THE PROJECT, INCLUDING SITE RESTORATION.

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/19/2020

DESIGNER/DRAFTER: KP
CHECKED BY: ME
SCALE AS NOTED

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_CIV_0115_0121_C012 (MISC 1).dgn

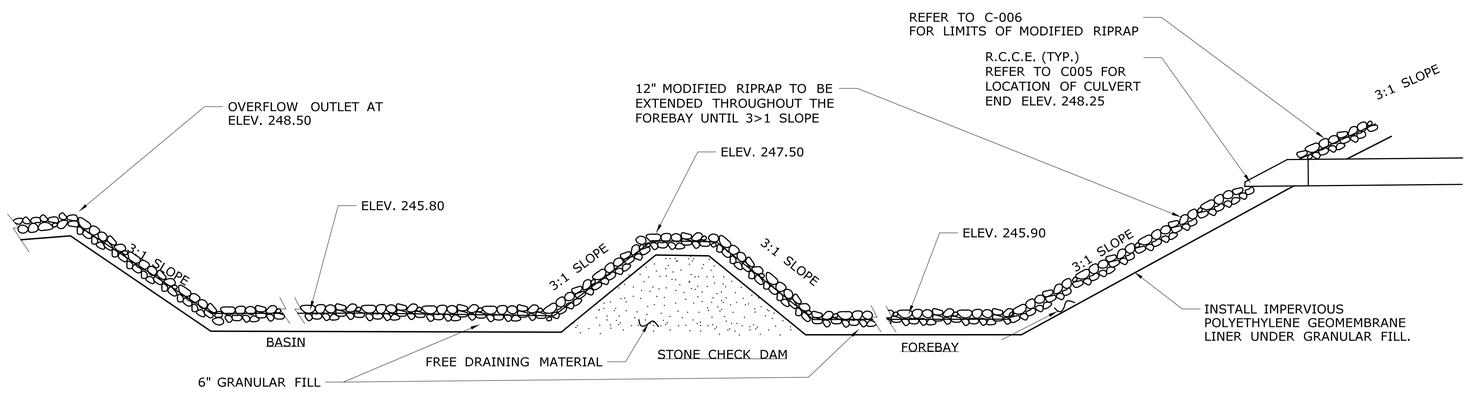
SIGNATURE/BLOCK: OFFICE OF ENGINEERING
APPROVED BY:

PROJECT TITLE: PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: PUTNAM

DRAWING TITLE: MISCELLANEOUS DETAILS 1

PROJECT NO. 115-121
DRAWING NO. C-012
SHEET NO. 04.12

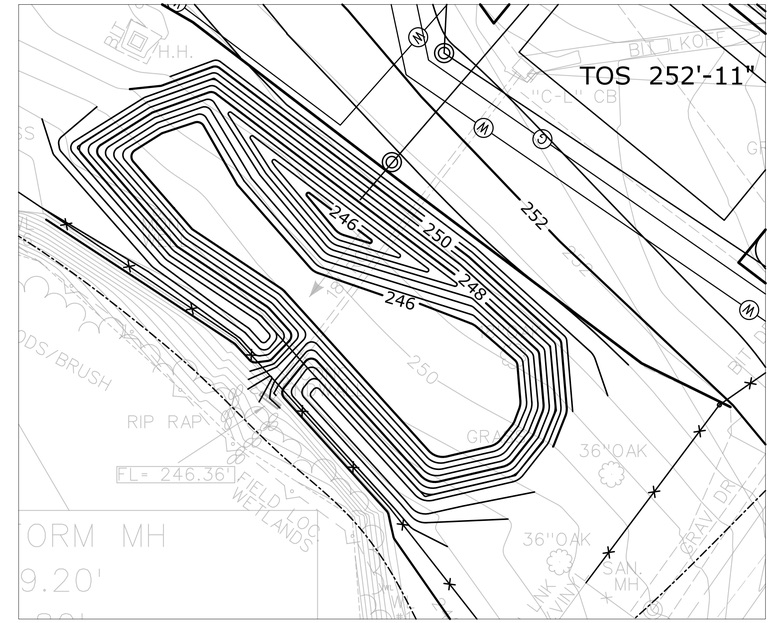


NOTE: ESTABLISH TURF ON THE REMAINDER OF THE STORMWATER BASIN SLOPES.

DETENTION BASIN

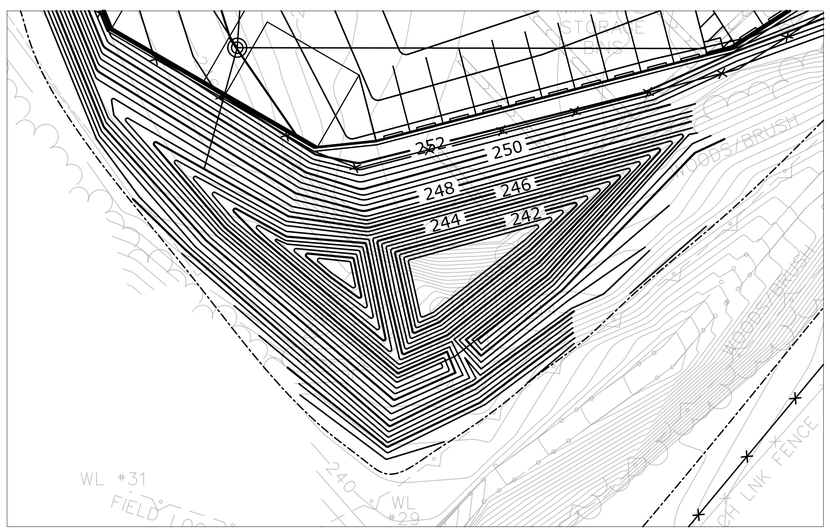
NOT TO SCALE

NOTES:
1. ESTABLISH TURF ON THE REMAINDER OF STORM WATER BASIN SLOPES.
2. BASIN TO BE UTILIZED DURING CONSTRUCTION.
3. RE-GRADING FINALIZED FOR POST CONSTRUCTION USE.
4. IMPERVIOUS POLYETHYLENE GEOMEMBRANE LINER SHALL EXTEND TO RIPRAP LIMITS.
5. IT IS THE CONTRACTORS RESPONSIBILITY TO STAY OUT OF DELINEATED WETLANDS.



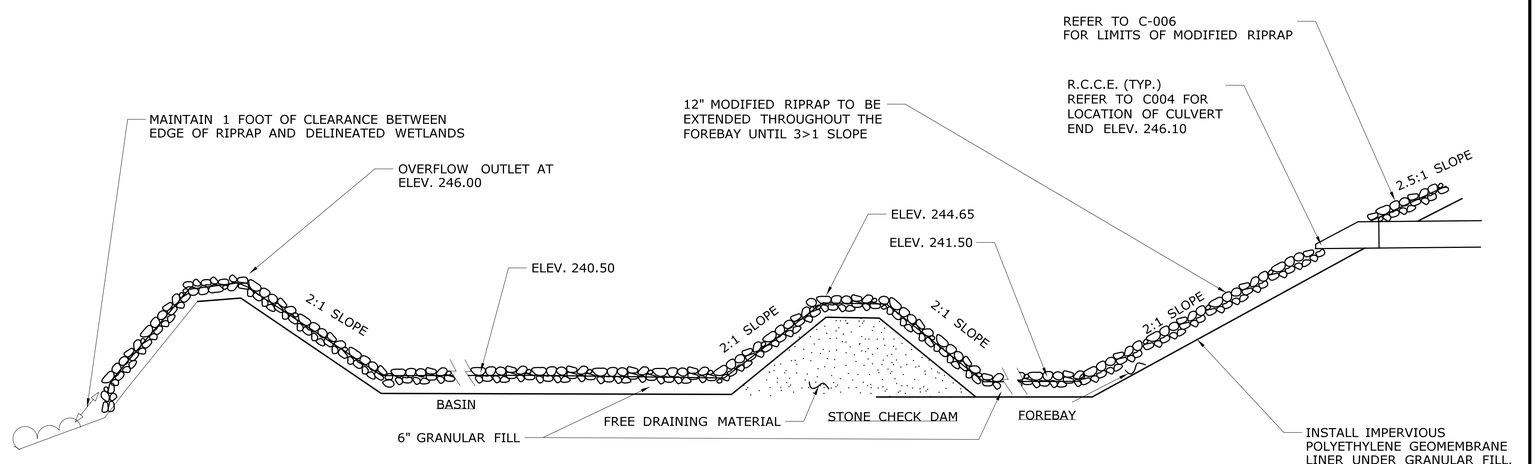
PLAN

SCALE 1" = 20'



PLAN

SCALE 1" = 20'



NOTE: ESTABLISH TURF ON THE REMAINDER OF THE STORMWATER BASIN SLOPES.

DETENTION BASIN

NOT TO SCALE

NOTES:
1. ESTABLISH TURF ON THE REMAINDER OF STORM WATER BASIN SLOPES.
2. BASIN TO BE UTILIZED DURING CONSTRUCTION.
3. RE-GRADING FINALIZED FOR POST CONSTRUCTION USE.
4. IMPERVIOUS POLYETHYLENE GEOMEMBRANE LINER SHALL EXTEND TO RIPRAP LIMITS.
5. IT IS THE CONTRACTORS RESPONSIBILITY TO STAY OUT OF DELINEATED WETLANDS.

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/19/2020

DESIGNER/DRAFTER: **KP**

CHECKED BY: **ME**

SCALE AS NOTED

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\FD_MSH_CIV_0115_0121_C017 (MISC 6).dgn

SIGNATURE/ BLOCK:

OFFICE OF ENGINEERING

APPROVED BY:

PROJECT TITLE:

PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

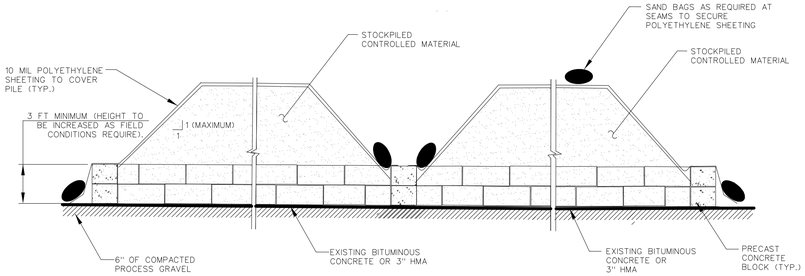
TOWN: **PUTNAM**

DRAWING TITLE: **MISCELLANEOUS DETAILS 6**

PROJECT NO. **115-121**

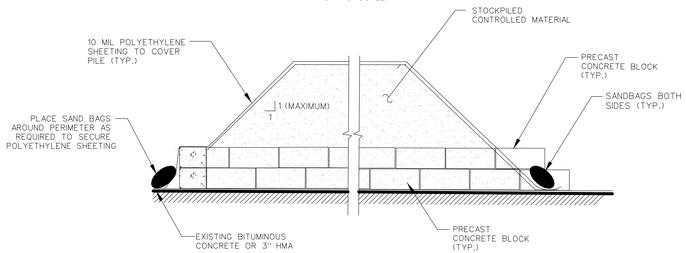
DRAWING NO. **C-017**

SHEET NO. **04.17**



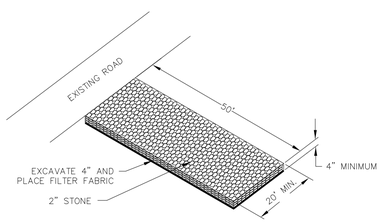
SECTION B-B

NOT TO SCALE



SECTION A-A

NOT TO SCALE



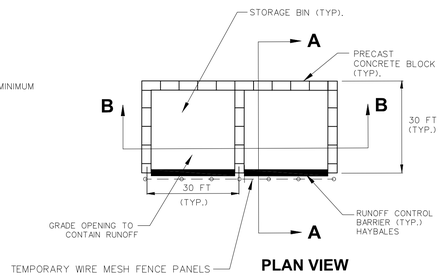
ANTI-TRACKING PAD

NOT TO SCALE

NOTES:
1) INSTALL ANTI-TRACKING PAD WHERE DIRECTED.

2) FOLLOWING REMOVAL OF THE ANTI-TRACKING PAD, BACKFILL TO ORIGINAL GRADE.

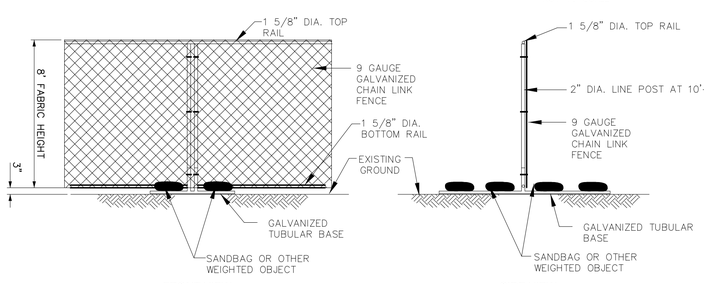
3) CONTRACTOR MAY ALSO PROPOSE A COMPOSITE TRACKOUT MAT AS MANUFACTURED BY FODS, OR APPROVED EQUAL.



PLAN VIEW

WASTE STOCKPILE AREA

NOT TO SCALE

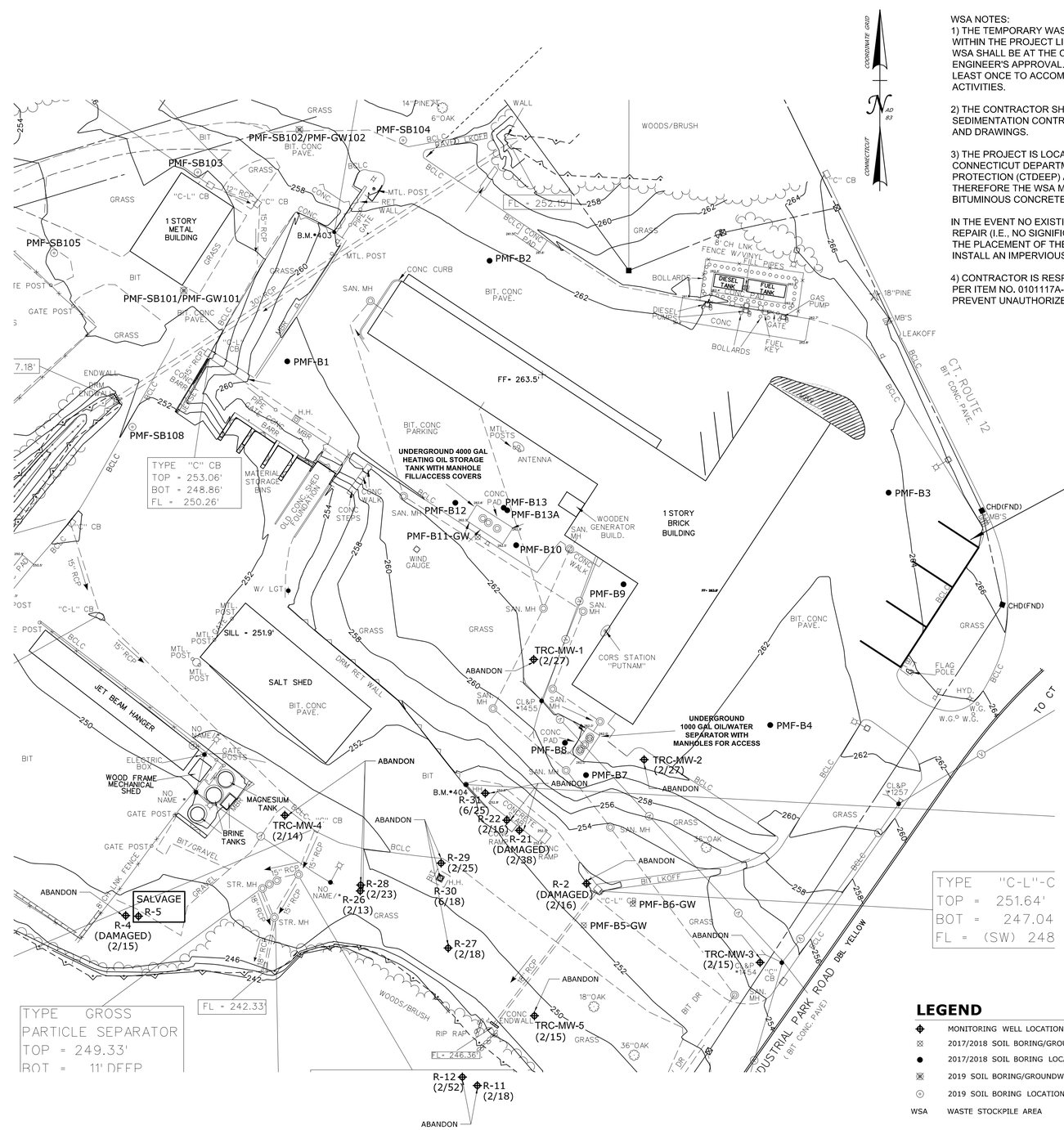


FRONT VIEW

SIDE VIEW

TEMPORARY WIRE MESH SECURITY FENCE DETAIL

NTS



WSA NOTES:
1) THE TEMPORARY WASTE STOCKPILE AREA (WSA) TO BE LOCATED WITHIN THE PROJECT LIMITS. PLACEMENT AND DIMENSIONS OF THE WSA SHALL BE AT THE CONTRACTOR'S DISCRETION WITH THE ENGINEER'S APPROVAL. THE WSA WILL NEED TO BE RELOCATED AT LEAST ONCE TO ACCOMMODATE THE SEQUENCING OF PROJECT ACTIVITIES.

2) THE CONTRACTOR SHALL INSTALL ALL EROSION AND SEDIMENTATION CONTROLS PER THE CONTRACT SPECIFICATIONS AND DRAWINGS.

3) THE PROJECT IS LOCATED WITHIN AN AREA DESIGNATED BY THE CONNECTICUT DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION (CTDEEP) AS A "LEVEL A" AQUIFER PROTECTION AREA, THEREFORE THE WSA MUST BE LOCATED ON IMPERVIOUS BITUMINOUS CONCRETE.

IN THE EVENT NO EXISTING BITUMINOUS CONCRETE IN GOOD REPAIR (I.E., NO SIGNIFICANT DETERIORATION) IS AVAILABLE FOR THE PLACEMENT OF THE STORAGE BINS, THE CONTRACTOR SHALL INSTALL AN IMPERVIOUS BASE AS NOTED IN THE WSA DETAIL.

4) CONTRACTOR IS RESPONSIBLE FOR MAINTAINING THE WSA AS PER ITEM NO. 0101117A-CONTROLLED MATERIALS HANDLING AND PREVENT UNAUTHORIZED ACCESS TO THE STORED MATERIAL.

LEGEND

- MONITORING WELL LOCATION (WELL DIAMETER IN INCHES/DEPTH IN FEET)
- 2017/2018 SOIL BORING/GROUNDWATER SAMPLE LOCATION
- 2017/2018 SOIL BORING LOCATION
- 2019 SOIL BORING/GROUNDWATER SAMPLE LOCATION
- 2019 SOIL BORING LOCATION
- WSA — WASTE STOCKPILE AREA

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/21/2020

DESIGNER/DRAFTER: L. BANE/R. HAMILTON
CHECKED BY: D. MARTIN
SCALE IN FEET 0 40 80
SCALE 1"=40'

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\Envir_Compl\ENV-002.dgn

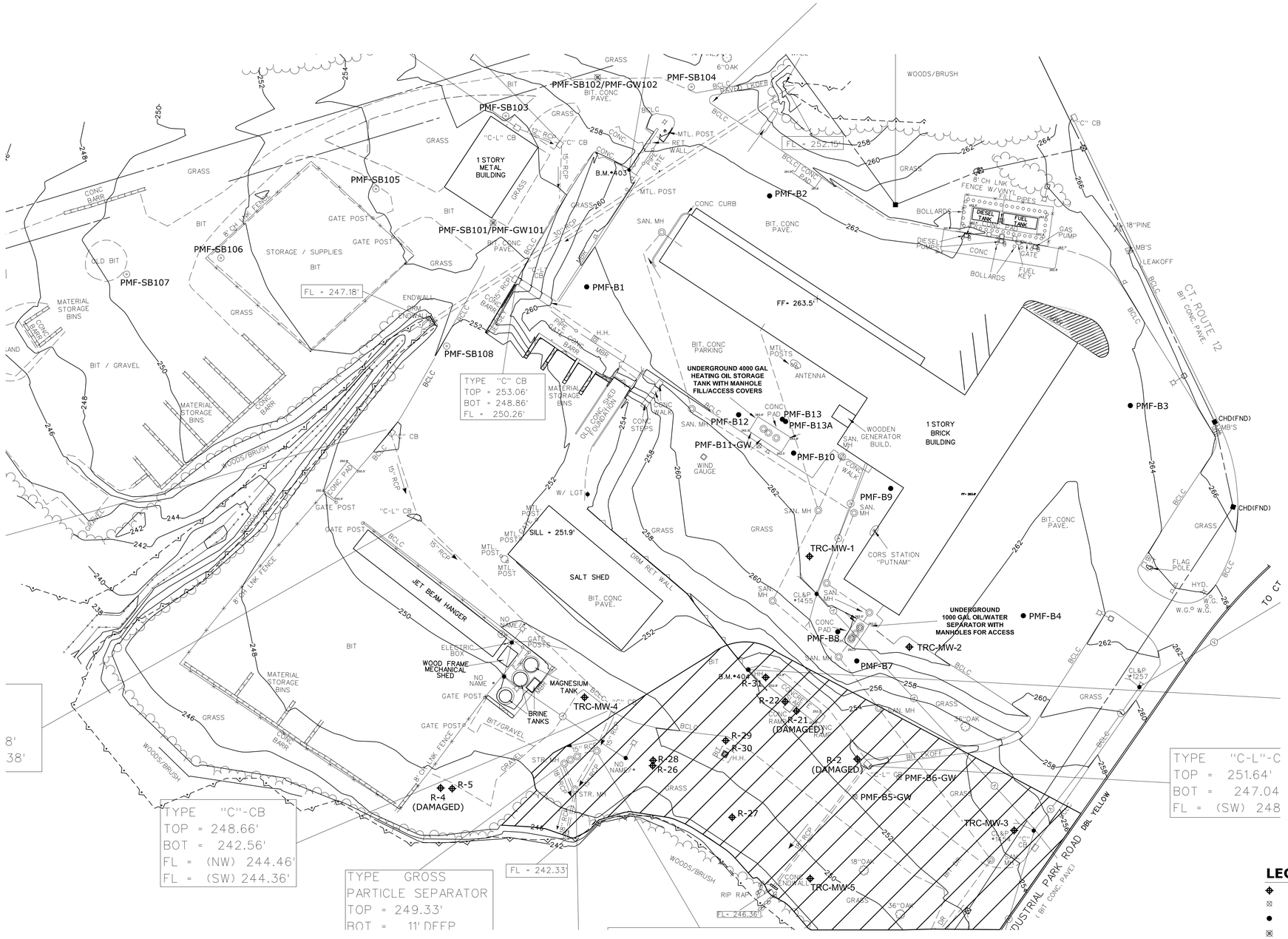
SIGNATURE/BLOCK:
TRC
21 Griffin Road North
Windsor, CT 06095

PROJECT TITLE:
PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: **PUTNAM**

DRAWING TITLE:
WASTE STOCKPILE AREA (WSA) DETAIL & MONITORING WELL ABANDONMENT PLAN

PROJECT NO. **115-121**
DRAWING NO. **ENV-002**
SHEET NO. **09.02**



LEGEND

- MONITORING WELL LOCATION
- 2017/2018 SOIL BORING/GROUNDWATER SAMPLE LOCATION
- 2017/2018 SOIL BORING LOCATION
- 2019 SOIL BORING/GROUNDWATER SAMPLE LOCATION
- 2019 SOIL BORING LOCATION
- GROUNDWATER AREA OF ENVIRONMENTAL CONCERN (GWAOEC)

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 5/21/2020

DESIGNER/DRAFTER: L. BANE/R. HAMILTON

CHECKED BY: D. MARTIN

SCALE IN FEET 0 40 80

SCALE 1"=40'

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\Envir_Compl\ENV-003.dgn

SIGNATURE/BLOCK:

TRC
21 Griffin Road North
Windsor, CT 06095

PROJECT TITLE:

PUTNAM REPAIR FACILITY AND MAINTENANCE FACILITY

TOWN: **PUTNAM**

DRAWING TITLE: **GROUNDWATER AREA OF ENVIROMENTAL CONCERN**

PROJECT NO. **115-121**

DRAWING NO. **ENV-003**

SHEET NO. **09.03**

APPENDIX D

Stormwater Monitoring Report Form

State Project No. 0115-0121

Connecticut Department of
Energy & Environmental Protection
Bureau of Materials Management & Compliance Assurance
Water Permitting & Enforcement Division

General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, issued 8/21/13, effective 10/1/13
Stormwater Monitoring Report

SITE INFORMATION

Permittee: _____

Mailing Address: _____

Business Phone: _____ ext.: _____ Fax: _____

Contact Person: _____ Title: _____

Site Name: _____

Site Address: _____

Receiving Water (name, basin): _____

Stormwater Permit No. GSN _____

SAMPLING INFORMATION (Submit a separate form for each outfall)

Outfall Designation: _____ Date/Time Collected: _____

Outfall Location(s) (lat/lon or map link): _____

Person Collecting Sample: _____

Storm Magnitude (inches): _____ Storm Duration (hours): _____

Size of Disturbed Area at any time: _____

MONITORING RESULTS

Sample #	Parameter	Method	Results (units)	Laboratory (if applicable)
1	Turbidity			
2	Turbidity			
3	Turbidity			
4	Turbidity			

(provide an attachment if more than 4 samples were taken for this outfall) Avg =

STATEMENT OF ACKNOWLEDGMENT

I certify that the data reported on this document were prepared under my direction or supervision in accordance with the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities. The information submitted is, to the best of my knowledge and belief, true, accurate and complete.

Authorized Official: _____

Signature: _____ Date: _____

Please send completed form to:

DEPARTMENT OF ENERGY & ENVIRONMENTAL PROTECTION
BUREAU OF MATERIALS MANAGEMENT AND COMPLIANCE ASSURANCE
79 ELM STREET
HARTFORD, CT 06106-5127
ATTN: NEAL WILLIAMS

APPENDIX E

Notice of Termination Form

State Project No. 0115-0121

General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities

Notice of Termination Form

Please complete and submit this form in accordance with the general permit (DEP-PED-GP-015) in order to ensure the proper handling of your termination. Print or type unless otherwise noted.

Note: Ensure that for commercial and industrial facilities, registrations under the *General Permit for the Discharge of Stormwater Associated with Industrial Activity* (DEP-PED-GP-014) or the *General Permit for the Discharge of Stormwater from Commercial Activities* (DEP-PED-GP-004) have been filed where applicable. For questions about the applicability of these general permits, please call the Department at 860-424-3018.

Part I: Registrant Information

1. Permit number: ***GSN***
2. Fill in the name of the registrant(s) as indicated on the registration certificate:

   Registrant:
3. Site Address:

   City/Town: State: Zip Code:
4. Date all storm drainage structures were cleaned of construction sediment:

   Date of Completion of Construction:

   Date of Last Inspection (must be at least three months after final stabilization pursuant to Section 6(b)(6)(D) of the general permit):
5. Check the post-construction activities at the site (check all that apply):

   ☐ Industrial ☐ Residential ☐ Commercial ☐ Capped Landfill

   ☐ Other (describe):

Part II: Certification

"I have personally examined and am familiar with the information submitted in this document and all attachments thereto, and I certify that, based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief. I understand that a false statement made in this document or its attachments may be punishable as a criminal offense, in accordance with Section 22a-6 of the Connecticut General Statutes, pursuant to Section 53a-157b of the Connecticut General Statutes, and in accordance with any other applicable statute."

Signature of Permittee	Date
Name of Permittee (print or type)	Title (if applicable)

Note: Please submit this Notice of Termination Form to:

STORMWATER PERMIT COORDINATOR
BUREAU OF WATER MANAGEMENT
DEPARTMENT OF ENVIRONMENTAL PROTECTION
79 ELM STREET
HARTFORD, CT 06106-5127

Construction Contracts - Required Contract Provisions
(State Funded Only Contracts)

Index

Index of Exhibits

1. Contractor Work Force Utilization / Equal Employment Opportunity

(a) The Contractor shall comply with the Contractor Work Force Utilization / Equal Employment Opportunity requirements attached at Exhibit B and hereby made part of this Contract, whenever a contractor or subcontractor at any tier performs construction work in excess of $10,000. These goals shall be included in each contract and subcontract. Goal achievement is calculated for each trade using the hours worked under each trade.

(b) Companies with contracts, agreements or purchase orders valued at $10,000 or more will develop and implement an Affirmative Action Plan utilizing the ConnDOT Affirmative Action Plan Guideline. This Plan shall be designed to further the provision of equal employment opportunity to all persons without regard to their race, color, religion, sex or national origin, and to promote the full realization of equal employment opportunity through a positive continuation program. Plans shall be updated as required by ConnDOT.

2. Contract Wage Rates

The Contractor shall comply with:

The State wage rate requirements indicated in Exhibit D hereof are hereby made part of this Contract.

Prevailing Wages for Work on State Highways; Annual Adjustments. With respect to contracts for work on state highways and bridges on state highways, the Contractor shall comply with the provisions of Section 31-54 and 31-55a of the Connecticut General Statutes, as revised.

As required by section 1.05.12 (Payrolls) of the State of Connecticut, Department of Transportation's Standard Specification for Roads, Bridges and Incidental Construction (FORM 817), as may be revised, every Contractor or subcontractor performing project work on a federal aid project is required to post the relevant prevailing wage rates as determined by the United States Secretary of Labor. The wage rate determinations shall be posted in prominent and easily accessible places at the work site.

3. Americans with Disabilities Act of 1990, as Amended

This provision applies to those Contractors who are or will be responsible for compliance with the terms of the Americans with Disabilities Act of 1990, as amended (42 U.S.C. 12101 et seq.), (Act), during the term of the Contract. The Contractor represents that it is familiar with the terms of this Act and that it is in compliance with the Act. Failure of the Contractor to satisfy this standard as the same applies to performance under this Contract, either now or during the term of the Contract as it may be amended, will render the Contract voidable at the option of the State upon notice to the contractor. The Contractor warrants that it will hold the State harmless and indemnify the State from any liability which may be imposed upon the State as a result of any failure of the Contractor to be in compliance with this Act, as the same applies to performance under this Contract.

4. Connecticut Statutory Labor Requirements

(a) Construction, Alteration or Repair of Public Works Projects; Wage Rates. The Contractor shall comply with Section 31-53 of the Connecticut General Statutes, as revised. The wages paid on an hourly basis to any person performing the work of any mechanic, laborer or worker on the work herein contracted to be done and the amount of payment or contribution paid or payable on behalf of each such person to any employee welfare fund, as defined in subsection (i)

of section 31-53 of the Connecticut General Statutes, shall be at a rate equal to the rate customary or prevailing for the same work in the same trade or occupation in the town in which such public works project is being constructed. Any contractor who is not obligated by agreement to make payment or contribution on behalf of such persons to any such employee welfare fund shall pay to each mechanic, laborer or worker as part of such person's wages the amount of payment or contribution for such person's classification on each pay day.

(b) Debarment List. Limitation on Awarding Contracts. The Contractor shall comply with Section 3l-53a of the Connecticut General Statutes, as revised.

(c) Construction Safety and Health Course. The Contractor shall comply with section 31-53b of the Connecticut General Statutes, as revised. The contractor shall furnish proof to the Labor Commissioner with the weekly certified payroll form for the first week each employee begins work on such project that any person performing the work of a mechanic, laborer or worker pursuant to the classifications of labor under section 31-53 of the Connecticut General Statutes, as revised, on such public works project, pursuant to such contract, has completed a course of at least ten hours in duration in construction safety and health approved by the federal Occupational Safety and Health Administration or, has completed a new miner training program approved by the Federal Mine Safety and Health Administration in accordance with 30 CFR 48 or, in the case of telecommunications employees, has completed at least ten hours of training in accordance with 29 CFR 1910.268.

Any employee required to complete a construction safety and health course as required that has not completed the course, shall have a maximum of fourteen (14) days to complete the course. If the employee has not been brought into compliance, they shall be removed from the project until such time as they have completed the required training.

Any costs associated with this notice shall be included in the general cost of the contract. In addition, there shall be no time granted to the contractor for compliance with this notice. The contractor's compliance with this notice and any associated regulations shall not be grounds for claims as outlined in Section 1.11 – "Claims".

(d) Awarding of Contracts to Occupational Safety and Health Law Violators Prohibited. The Contract is subject to Section 31-57b of the Connecticut General Statutes, as revised.

(e) Residents Preference in Work on Other Public Facilities. NOT APPLICABLE TO FEDERAL AID CONTRACTS. Pursuant to Section 31-52a of the Connecticut General Statutes, as revised, in the employment of mechanics, laborers or workmen to perform the work specified herein, preference shall be given to residents of the state who are, and continuously for at least six months prior to the date hereof have been, residents of this state, and if no such person is available, then to residents of other states

5. Tax Liability - Contractor's Exempt Purchase Certificate (CERT – 141)

The Contractor shall comply with Chapter 219 of the Connecticut General Statutes pertaining to tangible personal property or services rendered that is/are subject to sales tax. The Contractor is responsible for determining its tax liability. If the Contractor purchases materials or supplies pursuant to the Connecticut Department of Revenue Services' "Contractor's Exempt Purchase Certificate (CERT-141)," as may be revised, the Contractor acknowledges and agrees that title to such materials

and supplies installed or placed in the project will vest in the State simultaneously with passage of title from the retailers or vendors thereof, and the Contractor will have no property rights in the materials and supplies purchased.

Forms and instructions are available anytime by:

Internet: Visit the DRS website at www.ct.gov/DRS to download and print Connecticut tax forms; or
Telephone: Call 1-800-382-9463 (Connecticut calls outside the Greater Hartford calling area only) and select Option 2 or call 860-297-4753 (from anywhere).

6. Executive Orders

This contract is subject to the provisions of Executive Order No. Three of Governor Thomas J. Meskill, promulgated June 16, 1971, concerning labor employment practices, Executive Order No. Seventeen of Governor Thomas J. Meskill, promulgated February 15, 1973, concerning the listing of employment openings and Executive Order No. Sixteen of Governor John G. Rowland promulgated August 4, 1999, concerning violence in the workplace, all of which are incorporated into and are made a part of the contract as if they had been fully set forth in it. The contract may also be subject to Executive Order No. 14 of Governor M. Jodi Rell, promulgated April 17, 2006, concerning procurement of cleaning products and services and to Executive Order No. 49 of Governor Dannel P. Malloy, promulgated May 22, 2015, mandating disclosure of certain gifts to public employees and contributions to certain candidates for office. If Executive Order No. 14 and/or Executive Order No. 49 are applicable, they are deemed to be incorporated into and are made a part of the contract as if they had been fully set forth in it. At the Contractor's request, the Department shall provide a copy of these orders to the Contractor.

7. Non Discrimination Requirement (pursuant to section 4a-60 and 4a-60a of the Connecticut General Statutes, as revised): References to "minority business enterprises" in this Section are not applicable to Federal-aid projects/contracts. Federal-aid projects/contracts are instead subject to the Federal Disadvantaged Business Enterprise Program.

(a) For purposes of this Section, the following terms are defined as follows:

(1) "Commission" means the Commission on Human Rights and Opportunities;
(2) "Contract" and "contract" include any extension or modification of the Contract or contract;
(3) "Contractor" and "contractor" include any successors or assigns of the Contractor or contractor;
(4) "Gender identity or expression" means a person's gender-related identity, appearance or behavior, whether or not that gender-related identity, appearance or behavior is different from that traditionally associated with the person's physiology or assigned sex at birth, which gender-related identity can be shown by providing evidence including, but not limited to, medical history, care or treatment of the gender-related identity, consistent and uniform assertion of the gender-related identity or any other evidence that the gender-related identity is sincerely held, part of a person's core identity or not being asserted for an improper purpose.
(5) "good faith" means that degree of diligence which a reasonable person would exercise in the performance of legal duties and obligations;
(6) "good faith efforts" shall include, but not be limited to, those reasonable initial efforts necessary to comply with statutory or regulatory requirements and additional or substituted efforts when it is determined that such initial efforts will not be sufficient to comply with such requirements;
(7) "marital status" means being single, married as recognized by the state of Connecticut, widowed, separated or divorced;

(8) "mental disability" means one or more mental disorders, as defined in the most recent edition of the American Psychiatric Association's "Diagnostic and Statistical Manual of Mental Disorders", or a record of or regarding a person as having one or more such disorders;

(9) "minority business enterprise" means any small contractor or supplier of materials fifty-one percent or more of the capital stock, if any, or assets of which is owned by a person or persons: (1) who are active in the daily affairs of the enterprise, (2) who have the power to direct the management and policies of the enterprise, and (3) who are members of a minority, as such term is defined in subsection (a) of Connecticut General Statutes § 32-9n; and

(10) "public works contract" means any agreement between any individual, firm or corporation and the State or any political subdivision of the State other than a municipality for construction, rehabilitation, conversion, extension, demolition or repair of a public building, highway or other changes or improvements in real property, or which is financed in whole or in part by the State, including, but not limited to, matching expenditures, grants, loans, insurance or guarantees.

For purposes of this Section, the terms "Contract" and "contract" do not include a contract where each contractor is (1) a political subdivision of the State of Connecticut, including, but not limited to municipalities, unless the contract is a municipal public works contract or quasi-public agency project contract, (2) any other state of the United States, including but not limited to, the District of Columbia, Puerto Rico, U.S. territories and possessions, and federally recognized Indian tribal governments, as defined in Connecticut General Statutes § 1-267, (3) the federal government, (4) a foreign government, or (5) an agency of a subdivision, state or government described in subdivision (1), (2), (3), or (4) of this subsection.

(b) (1) The Contractor agrees and warrants that in the performance of the Contract such Contractor will not discriminate or permit discrimination against any person or group of persons on the grounds of race, color, religious creed, age, marital status, national origin, ancestry, sex, gender identity or expression, status as a veteran, intellectual disability, mental disability or physical disability, including, but not limited to, blindness, unless it is shown by such Contractor that such disability prevents performance of the work involved, in any manner prohibited by the laws of the United States or of the State of Connecticut; and the Contractor further agrees to take affirmative action to insure that applicants with job-related qualifications are employed and that employees are treated when employed without regard to their race, color, religious creed, age, marital status, national origin, ancestry, sex, gender identity or expression, status as a veteran, intellectual disability, mental disability or physical disability, including, but not limited to, blindness, unless it is shown by the Contractor that such disability prevents performance of the work involved; (2) the Contractor agrees, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, to state that it is an "affirmative action-equal opportunity employer" in accordance with regulations adopted by the Commission; (3) the Contractor agrees to provide each labor union or representative of workers with which the Contractor has a collective bargaining agreement or other contract or understanding and each vendor with which the Contractor has a contract or understanding, a notice to be provided by the Commission, advising the labor union or workers' representative of the Contractor's commitments under this section and to post copies of the notice in conspicuous places available to employees and applicants for employment; (4) the Contractor agrees to comply with each provision of this Section and Connecticut General Statutes §§ 46a-68e and 46a-68f and with each regulation or relevant order issued by said Commission pursuant to Connecticut General Statutes §§ 46a-56, 46a-68e and 46a-68f; and (5) the Contractor agrees to provide the Commission on Human Rights and Opportunities with such information requested by the Commission, and permit access to pertinent books, records and accounts, concerning the employment practices and procedures of the Contractor as relate to the provisions of this Section

and Connecticut General Statutes § 46a-56. If the contract is a public works contract, the Contractor agrees and warrants that he will make good faith efforts to employ minority business enterprises as subcontractors and suppliers of materials on such public works projects.

(c) Determination of the Contractor's good faith efforts shall include, but shall not be limited to, the following factors: The Contractor's employment and subcontracting policies, patterns and practices; affirmative advertising, recruitment and training; technical assistance activities and such other reasonable activities or efforts as the Commission may prescribe that are designed to ensure the participation of minority business enterprises in public works projects.

(d) The Contractor shall develop and maintain adequate documentation, in a manner prescribed by the Commission, of its good faith efforts.

(e) The Contractor shall include the provisions of subsection (b) of this Section in every subcontract or purchase order entered into in order to fulfill any obligation of a contract with the State and such provisions shall be binding on a subcontractor, vendor or manufacturer unless exempted by regulations or orders of the Commission. The Contractor shall take such action with respect to any such subcontract or purchase order as the Commission may direct as a means of enforcing such provisions including sanctions for noncompliance in accordance with Connecticut General Statutes §46a-56; provided if such Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Commission, the Contractor may request the State of Connecticut to enter into any such litigation or negotiation prior thereto to protect the interests of the State and the State may so enter.

(f) The Contractor agrees to comply with the regulations referred to in this Section as they exist on the date of this Contract and as they may be adopted or amended from time to time during the term of this Contract and any amendments thereto.

(g) (1) The Contractor agrees and warrants that in the performance of the Contract such Contractor will not discriminate or permit discrimination against any person or group of persons on the grounds of sexual orientation, in any manner prohibited by the laws of the United States or the State of Connecticut, and that employees are treated when employed without regard to their sexual orientation; (2) the Contractor agrees to provide each labor union or representative of workers with which such Contractor has a collective bargaining agreement or other contract or understanding and each vendor with which such Contractor has a contract or understanding, a notice to be provided by the Commission on Human Rights and Opportunities advising the labor union or workers' representative of the Contractor's commitments under this section, and to post copies of the notice in conspicuous places available to employees and applicants for employment; (3) the Contractor agrees to comply with each provision of this section and with each regulation or relevant order issued by said Commission pursuant to Connecticut General Statutes § 46a-56; and (4) the Contractor agrees to provide the Commission on Human Rights and Opportunities with such information requested by the Commission, and permit access to pertinent books, records and accounts, concerning the employment practices and procedures of the Contractor which relate to the provisions of this Section and Connecticut General Statutes § 46a-56.

(h) The Contractor shall include the provisions of the foregoing paragraph in every subcontract or purchase order entered into in order to fulfill any obligation of a contract with the State and such provisions shall be binding on a subcontractor, vendor or manufacturer unless exempted by regulations or orders of the Commission. The Contractor shall take such action with respect to any such subcontract or purchase order as the Commission may direct as a means of enforcing such provisions including sanctions for noncompliance in accordance with Connecticut General Statutes § 46a-56; provided, if such Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Commission, the Contractor may request the State of Connecticut to enter into any such litigation or negotiation prior thereto to protect the interests of the State and the State may so enter.

Please be aware the Nondiscrimination Certifications can be found at the Office of Policy and Management website:

https://portal.ct.gov/OPM/Fin-PSA/Forms/Nondiscrimination-Certification

8. Whistleblower Provision

The following clause is applicable if the Contract has a value of Five Million Dollars ($5,000,000) or more.

Whistleblowing. This Contract may be subject to the provisions of Section 4-61dd of the Connecticut General Statutes. In accordance with this statute, if an officer, employee or appointing authority of the Contractor takes or threatens to take any personnel action against any employee of the Contractor in retaliation for such employee's disclosure of information to any employee of the contracting state or quasi-public agency or the Auditors of Public Accounts or the Attorney General under the provisions of subsection (a) of such statute, the Contractor shall be liable for a civil penalty of not more than five thousand dollars for each offense, up to a maximum of twenty per cent of the value of this Contract. Each violation shall be a separate and distinct offense and in the case of a continuing violation, each calendar day's continuance of the violation shall be deemed to be a separate and distinct offense. The State may request that the Attorney General bring a civil action in the Superior Court for the Judicial District of Hartford to seek imposition and recovery of such civil penalty. In accordance with subsection (f) of such statute, each large state contractor, as defined in the statute, shall post a notice of the provisions of the statute relating to large state contractors in a conspicuous place which is readily available for viewing by the employees of the Contractor.

9. Connecticut Freedom of Information Act

(a) Disclosure of Records. This Contract may be subject to the provisions of section 1-218 of the Connecticut General Statutes. In accordance with this statute, each contract in excess of two million five hundred thousand dollars between a public agency and a person for the performance of a governmental function shall (a) provide that the public agency is entitled to receive a copy of records and files related to the performance of the governmental function, and (b) indicate that such records and files are subject to FOIA and may be disclosed by the public agency pursuant to FOIA. No request to inspect or copy such records or files shall be valid unless the request is made to the public agency in accordance with FOIA. Any complaint by a person who is denied the right to inspect or copy such records or files shall be brought to the Freedom of Information Commission in accordance with the provisions of sections 1-205 and 1-206 of the Connecticut General Statutes.

(b) Confidential Information. The State will afford due regard to the Contractor's request for the protection of proprietary or confidential information which the State receives from the Contractor. However, all materials associated with the Contract are subject to the terms of the FOIA and all corresponding rules, regulations and interpretations. In making such a request, the Contractor may not merely state generally that the materials are proprietary or confidential in nature and not, therefore, subject to release to third parties. Those particular sentences, paragraphs, pages or sections that the Contractor believes are exempt from disclosure under the FOIA must be specifically identified as such. Convincing explanation and rationale sufficient to justify each exemption consistent with the FOIA must accompany the request. The rationale and explanation must be stated in terms of the prospective harm to the competitive position of the Contractor that would result if the identified material were to be released and the reasons why the materials are legally exempt from release pursuant to the FOIA. To the extent that any other provision or part of the Contract conflicts or is in any way inconsistent with this section, this section controls and

shall apply and the conflicting provision or part shall not be given effect. If the Contractor indicates that certain documentation is submitted in confidence, by specifically and clearly marking the documentation as "CONFIDENTIAL," DOT will first review the Contractor's claim for consistency with the FOIA (that is, review that the documentation is actually a trade secret or commercial or financial information and not required by statute), and if determined to be consistent, will endeavor to keep such information confidential to the extent permitted by law. See, *e.g.*, Conn. Gen. Stat. §1-210(b)(5)(A-B). The State, however, has no obligation to initiate, prosecute or defend any legal proceeding or to seek a protective order or other similar relief to prevent disclosure of any information that is sought pursuant to a FOIA request. Should the State withhold such documentation from a Freedom of Information requester and a complaint be brought to the Freedom of Information Commission, the Contractor shall have the burden of cooperating with DOT in defense of that action and in terms of establishing the availability of any FOIA exemption in any proceeding where it is an issue. In no event shall the State have any liability for the disclosure of any documents or information in its possession which the State believes are required to be disclosed pursuant to the FOIA or other law.

10. Service of Process

The Contractor, if not a resident of the State of Connecticut, or, in the case of a partnership, the partners, if not residents, hereby appoints the Secretary of State of the State of Connecticut, and his successors in office, as agent for service of process for any action arising out of or as a result of this Contract; such appointment to be in effect throughout the life of this Contract and six (6) years thereafter.

11. Substitution of Securities for Retainages on State Contracts and Subcontracts

This Contract is subject to the provisions of Section 3-ll2a of the General Statutes of the State of Connecticut, as revised.

12. Health Insurance Portability and Accountability Act of 1996 (HIPAA)

The Contractor shall comply, if applicable, with the Health Insurance Portability and Accountability Act of 1996 and, pursuant thereto, the provisions attached at Exhibit C, and hereby made part of this Contract.

13. Forum and Choice of Law

Forum and Choice of Law. The parties deem the Contract to have been made in the City of Hartford, State of Connecticut. Both parties agree that it is fair and reasonable for the validity and construction of the Contract to be, and it shall be, governed by the laws and court decisions of the State of Connecticut, without giving effect to its principles of conflicts of laws. To the extent that any immunities provided by Federal law or the laws of the State of Connecticut do not bar an action against the State, and to the extent that these courts are courts of competent jurisdiction, for the purpose of venue, the complaint shall be made returnable to the Judicial District of Hartford only or shall be brought in the United States District Court for the District of Connecticut only, and shall not be transferred to any other court, provided, however, that nothing here constitutes a waiver or compromise of the sovereign immunity of the State of Connecticut. The Contractor waives any objection which it may now have or will have to the laying of venue of any Claims in any forum and further irrevocably submits to such jurisdiction in any suit, action or proceeding.

14. Summary of State Ethics Laws

Pursuant to the requirements of section 1-101qq of the Connecticut General Statutes, the summary of State ethics laws developed by the State Ethics Commission pursuant to section 1-81b of the Connecticut General Statutes is incorporated by reference into and made a part of the Contract as if the summary had been fully set forth in the Contract.

15. Audit and Inspection of Plants, Places of Business and Records

(a) The State and its agents, including, but not limited to, the Connecticut Auditors of Public Accounts, Attorney General and State's Attorney and their respective agents, may, at reasonable hours, inspect and examine all of the parts of the Contractor's and Contractor Parties' plants and places of business which, in any way, are related to, or involved in, the performance of this Contract. For the purposes of this Section, "Contractor Parties" means the Contractor's members, directors, officers, shareholders, partners, managers, principal officers, representatives, agents, servants, consultants, employees or any one of them or any other person or entity with whom the Contractor is in privity of oral or written contract and the Contractor intends for such other person or entity to Perform under the Contract in any capacity.

(b) The Contractor shall maintain, and shall require each of the Contractor Parties to maintain, accurate and complete Records. The Contractor shall make all of its and the Contractor Parties' Records available at all reasonable hours for audit and inspection by the State and its agents.

(c) The State shall make all requests for any audit or inspection in writing and shall provide the Contractor with at least twenty-four (24) hours' notice prior to the requested audit and inspection date. If the State suspects fraud or other abuse, or in the event of an emergency, the State is not obligated to provide any prior notice.

(d) The Contractor shall keep and preserve or cause to be kept and preserved all of its and Contractor Parties' Records until three (3) years after the latter of (i) final payment under this Agreement, or (ii) the expiration or earlier termination of this Agreement, as the same may be modified for any reason. The State may request an audit or inspection at any time during this period. If any Claim or audit is started before the expiration of this period, the Contractor shall retain or cause to be retained all Records until all Claims or audit findings have been resolved.

(e) The Contractor shall cooperate fully with the State and its agents in connection with an audit or inspection. Following any audit or inspection, the State may conduct and the Contractor shall cooperate with an exit conference.

(f) The Contractor shall incorporate this entire Section verbatim into any contract or other agreement that it enters into with any Contractor Party.

16. Campaign Contribution Restriction

For all State contracts, defined in Conn. Gen. Stat. §9-612(f)(1) as having a value in a calendar year of $50,000 or more, or a combination or series of such agreements or contracts having a value of $100,000 or more, the authorized signatory to this contract expressly acknowledges receipt of the State Elections Enforcement Commission's notice advising state contractors of state campaign contribution and solicitation prohibitions, and will inform its principals of the contents of the notice, as set forth in "Notice to Executive Branch State Contractors and Prospective State Contractors of Campaign Contribution and Solicitation Limitations," a copy of which is attached hereto and hereby made a part of this contract, attached as Exhibit D.

17. Tangible Personal Property

(a) The Contractor on its behalf and on behalf of its Affiliates, as defined below, shall comply with the provisions of Conn. Gen. Stat. §12-411b, as follows:

(1) For the term of the Contract, the Contractor and its Affiliates shall collect and remit to the State of Connecticut, Department of Revenue Services, any Connecticut use tax due under the provisions of Chapter 219 of the Connecticut General Statutes for items of tangible personal property sold by the Contractor or by any of its Affiliates in the same manner as if the Contractor and such Affiliates were engaged in the business of selling tangible personal property for use in Connecticut and had sufficient nexus under the provisions of Chapter 219 to be required to collect Connecticut use tax;

(2) A customer's payment of a use tax to the Contractor or its Affiliates relieves the customer of liability for the use tax;

(3) The Contractor and its Affiliates shall remit all use taxes they collect from customers on or before the due date specified in the Contract, which may not be later than the last day of the month next succeeding the end of a calendar quarter or other tax collection period during which the tax was collected;

(4) The Contractor and its Affiliates are not liable for use tax billed by them but not paid to them by a customer; and

(5) Any Contractor or Affiliate who fails to remit use taxes collected on behalf of its customers by the due date specified in the Contract shall be subject to the interest and penalties provided for persons required to collect sales tax under chapter 219 of the general statutes.

(b) For purposes of this section of the Contract, the word "Affiliate" means any person, as defined in section 12-1 of the general statutes, that controls, is controlled by, or is under common control with another person. A person controls another person if the person owns, directly or indirectly, more than ten per cent of the voting securities of the other person. The word "voting security" means a security that confers upon the holder the right to vote for the election of members of the board of directors or similar governing body of the business, or that is convertible into, or entitles the holder to receive, upon its exercise, a security that confers such a right to vote. "Voting security" includes a general partnership interest.

(c) The Contractor represents and warrants that each of its Affiliates has vested in the Contractor plenary authority to so bind the Affiliates in any agreement with the State of Connecticut. The Contractor on its own behalf and on behalf of its Affiliates shall also provide, no later than 30 days after receiving a request by the State's contracting authority, such information as the State may require to ensure, in the State's sole determination, compliance with the provisions of Chapter 219 of the Connecticut General Statutes, including, but not limited to, §12-411b.

18. Bid Rigging and/or Fraud – Notice to Contractor

The Connecticut Department of Transportation is cooperating with the U.S. Department of Transportation and the Justice Department in their investigation into highway construction contract bid rigging and/or fraud.

A toll-free "HOT LINE" telephone number 800-424-9071 has been established to receive information from contractors, subcontractors, manufacturers, suppliers or anyone with knowledge of bid rigging and/or fraud, either past or current. The "HOT LINE" telephone number will be available during normal working hours (8:00 am – 5:00 pm EST). Information will be treated confidentially and anonymity respected.

19. Consulting Agreement Affidavit

The Contractor shall comply with Connecticut General Statutes Section 4a-81(a) and 4a-81(b), as revised. Pursuant to Public Act 11-229, after the initial submission of the form, if there is a change in the information contained in the form, a contractor shall submit the updated form, as applicable, either (i) not later than thirty (30) days after the effective date of such change or (ii) prior to execution of any new contract, whichever is earlier.

The Affidavit/Form may be submitted in written format or electronic format through the Department of Administrative Services (DAS) website.

EXHIBIT A

CONTRACTOR WORKFORCE UTILIZATION / EQUAL EMPLOYMENT OPPORTUNITY

1. **Project Workforce Utilization Goals:**
   These goals are applicable to all the Contractor's construction work (whether or not it is Federal or Federally assisted or funded) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for the geographical area where the work is actually performed.

   Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications which contain the applicable goals for minority and female participation.

   The goals for minority and female utilization are expressed in percentage terms for the contractor's aggregate work-force in each trade on all construction work in the covered area, are referenced in the Appendix A below.

STATE FUNDED PROJECTS (only)
APPENDIX A
(Labor Market Goals)

LABOR MARKET AREA GOAL				***Minority*** **Female**
Bridgeport				**22.7%** **1.4%**
Ansonia	Beacon Falls	Bridgeport	Derby	
Easton	Fairfield	Milford	Monroe	
Oxford	Seymour	Shelton	Stratford	
Trumbull				
Danbury				**10.7%** **3.8%**
Bethel	Bridgewater	Brookfield	Danbury	
Kent	New Fairfield	New Milford	Newtown	
Redding	Ridgefield	Roxbury	Sherman	
Washington				
Danielson				**4.3%** **1.8%**
Brooklyn	Eastford	Hampton	Killingly	
Pomfret	Putnam	Scotland	Sterling	
Thompson	Voluntown	Union	Woodstock	
Hartford				**13.7%** **2.1%**
Andover	Ashford	Avon	Barkhamsted	

Belin	Bloomfield	Bolton	Bristol
Burlington	Canton	Chaplin	Colchester
Columbia	Coventry	Cromwell	Durham
East Granby	East Haddam	East Hampton	East Hartford
East Windsor	Ellington	Enfield	Farmington
Glastonbury	Granby	Haddam	Hartford
Harwinton	Hebron	Lebanon	Manchester
Mansfield	Marlborough	Middlefield	Middletown
Newington	Plainville	Plymouth	Portland
Rocky Hill	Simsbury	Somers	South Windsor
Southington	Stafford	Suffield	Tolland
Vernon	West Hartford	Wethersfield	Willington
Winchester	Windham	Windsor	Windsor Locks

Lower River	**4.3%**
1.8%	

Chester	Deep River	Essex	Old Lyme
Westbrook			

LABOR MARKET AREA GOAL ***Minority***
Female

New Haven	**17.9%**
3.1%	

Bethany	Branford	Cheshire	Clinton
East Haven	Guilford	Hamden	Killingworth
Madison	Meriden	New Haven	North Branford
North Haven	Orange	Wallingford	West Haven
Woodbridge			

New London	**7.4%**
3.1%	

Bozrah	Canterbury	East Lyme	Franklin
Griswold	Groton	Ledyard	Lisbon
Montville	New London	North Stonington	Norwich
Old Lyme	Old Saybrook	Plainfield	Preston
Salem	Sprague	Stonington	Waterford
Hopkinton	RI – Westerly Rhode Island		

Stamford	**33.2%**
2.1%	

Darien	Greenwich	New Canaan	Norwalk
Stamford	Weston	Westport	Wilton

Torrington	**4.3%**
1.8%	

Canaan	Colebrook	Cornwall	Goshen
Hartland	Kent	Litchfield	Morris
Norfolk	North Canaan	Salisbury	Sharon

Torrington	Warren		
Waterbury			**12.4%**
1.6%			
Bethlehem	Middlebury	Naugatuck	Prospect
Southbury	Thomaston	Waterbury	Watertown
Wolcott	Woodbury		

Rev. 4/24/2019

EXHIBIT B

Health Insurance Portability and Accountability Act of 1996 ("HIPAA").

(a) If the Contactor is a Business Associate under the requirements of the Health Insurance Portability and Accountability Act of 1996 ("HIPAA"), the Contractor must comply with all terms and conditions of this Section of the Contract. If the Contractor is not a Business Associate under HIPAA, this Section of the Contract does not apply to the Contractor for this Contract.

(b) The Contractor is required to safeguard the use, publication and disclosure of information on all applicants for, and all clients who receive, services under the Contract in accordance with all applicable federal and state law regarding confidentiality, which includes but is not limited to HIPAA, more specifically with the Privacy and Security Rules at 45 C.F.R. Part 160 and Part 164, subparts A, C, and E; and

(c) The State of Connecticut Agency named on page 1 of this Contract (hereinafter the "Department") is a "covered entity" as that term is defined in 45 C.F.R. § 160.103; and

(d) The Contractor, on behalf of the Department, performs functions that involve the use or disclosure of "individually identifiable health information," as that term is defined in 45 C.F.R. § 160.103; and

(e) The Contractor is a "business associate" of the Department, as that term is defined in 45 C.F.R. § 160.103; and

(f) The Contractor and the Department agree to the following in order to secure compliance with the HIPAA, the requirements of Subtitle D of the Health Information Technology for Economic and Clinical Health Act (hereinafter the HITECH Act), (Pub. L. 111-5, sections 13400 to 13423), and more specifically with the Privacy and Security Rules at 45 C.F.R. Part 160 and Part 164, subparts A, C, and E.

(g) Definitions

(1) "Breach shall have the same meaning as the term is defined in section 13400 of the HITECH Act (42 U.S.C. §17921(1))

(2) "Business Associate" shall mean the Contractor.

(3) "Covered Entity" shall mean the Department of the State of Connecticut named on page 1 of this Contract.

(4) "Designated Record Set" shall have the same meaning as the term "designated record set" in 45 C.F.R. § 164.501.

(5) "Electronic Health Record" shall have the same meaning as the term is defined in section 13400 of the HITECH Act (42 U.S.C. §17921(5))

(6) "Individual" shall have the same meaning as the term "individual"' in 45 C.F.R. § 160.103 and shall include a person who qualifies as a personal representative as defined in 45 C.F.R. § 164.502(g).

(7) "Privacy Rule" shall mean the Standards for Privacy of Individually Identifiable Health Information at 45 C.F.R. part 160 and parts 164, subparts A and E.

(8) "Protected Health Information" or "PHI" shall have the same meaning as the term "protected health information" in 45 C.F.R. § 160.103, limited to information created or received by the Business Associate from or on behalf of the Covered Entity.

(9) "Required by Law"' shall have the same meaning as the term "required by law" in 45 C.F.R. § 164.103.

(10) "Secretary" shall mean the Secretary of the Department of Health and Human Services or his designee.

(11) "More stringent" shall have the same meaning as the term "more stringent" in 45 C.F.R. § 160.202.

(12) "This Section of the Contract" refers to the HIPAA Provisions stated herein, in their entirety.

(13) "Security Incident" shall have the same meaning as the term "security incident" in 45 C.F.R.§ 164.304.

(14) "Security Rule" shall mean the Security Standards for the Protection of Electronic Protected Health Information at 45 C.F.R. part 160 and parts 164, subpart A and C.

(15) "Unsecured protected health information" shall have the same meaning as the term as defined in section 13402(h)(1)(A) of HITECH. Act. (42 U.S.C. §17932(h)(1)(A)).

(h) Obligations and Activities of Business Associates.

(1) Business Associate agrees not to use or disclose PHI other than as permitted or required by this Section of the Contract or as Required by Law.

(2) Business Associate agrees to use appropriate safeguards to prevent use or disclosure of PHI other than as provided for in this Section of the Contract.

(3) Business Associate agrees to use administrative, physical and technical safeguards that reasonably and appropriately protect the confidentiality, integrity, and availability of electronic protected health information that it creates, receives, maintains, or transmits on behalf of the Covered Entity.

(4) Business Associate agrees to mitigate, to the extent practicable, any harmful effect that is known to the Business Associate of a use or disclosure of PHI by Business Associate in violation of this Section of the Contract.

(5) Business Associate agrees to report to Covered Entity any use or disclosure of PHI not provided for by this Section of the Contract or any security incident of which it becomes aware.

(6) Business Associate agrees to insure that any agent, including a subcontractor, to whom it provides PHI received from, or created or received by Business Associate, on behalf of the Covered Entity, agrees to the same restrictions and conditions that apply through this Section of the Contract to Business Associate with respect to such information.

(7) Business Associate agrees to provide access, at the request of the Covered Entity, and in the time and manner agreed to by the parties, to PHI in a Designated Record Set, to Covered Entity or, as directed by Covered Entity, to an Individual in order to meet the requirements under 45 C.F.R. § 164.524.

(8) Business Associate agrees to make any amendments to PHI in a Designated Record Set that the Covered Entity directs or agrees to pursuant to 45 C.F.R. § 164.526 at the request of the Covered Entity, and in the time and manner agreed to by the parties.

(9) Business Associate agrees to make internal practices, books, and records, including policies and procedures and PHI, relating to the use and disclosure of PHI received from, or created or received by, Business Associate on behalf of Covered Entity, available to Covered Entity or to the Secretary in a time and manner agreed to by the parties or designated by the Secretary, for purposes of the Secretary determining Covered Entity's compliance with the Privacy Rule.

(10) Business Associate agrees to document such disclosures of PHI and information related to such disclosures as would be required for Covered Entity to respond to a request by an Individual for an accounting of disclosures of PHI in accordance with 45 C.F.R. § 164.528 and section 13405 of the HITECH Act (42 U.S.C. § 17935) and any regulations promulgated thereunder.

(11) Business Associate agrees to provide to Covered Entity, in a time and manner agreed to by the parties, information collected in accordance with clause h. (10) of this Section of the Contract, to permit Covered Entity to respond to a request by an Individual for an accounting of disclosures of PHI in accordance with 45 C.F.R. § 164.528 and section 13405 of the HITECH Act (42 U.S.C. § 17935) and any regulations promulgated thereunder. Business Associate agrees at the Covered Entity's direction to provide an accounting of disclosures of PHI directly to an individual in accordance with 45 C.F.R. § 164.528 and section 13405 of the HITECH Act (42 U.S.C. § 17935) and any regulations promulgated thereunder.

(12) Business Associate agrees to comply with any state or federal law that is more stringent than the Privacy Rule.

(13) Business Associate agrees to comply with the requirements of the HITECH Act relating to privacy and security that are applicable to the Covered Entity and with the requirements of 45 C.F.R. sections 164.504(e), 164.308, 164.310, 164.312, and 164.316.

(14) In the event that an individual requests that the Business Associate (a) restrict disclosures of PHI; (b) provide an accounting of disclosures of the individual's PHI; or (c) provide a copy of the individual's PHI in an electronic health record, the Business Associate agrees to notify the covered entity, in writing, within two business days of the request.

(15) Business Associate agrees that it shall not, directly or indirectly, receive any remuneration in exchange for PHI of an individual without (1) the written approval of the covered entity, unless receipt of remuneration in exchange for PHI is expressly authorized by this Contract and (2) the valid authorization of the individual, except for the purposes provided under section 13405(d)(2) of the HITECH Act,(42 U.S.C. § 17935(d)(2)) and in any accompanying regulations

(16) Obligations in the Event of a Breach

A. The Business Associate agrees that, following the discovery of a breach of unsecured protected health information, it shall notify the Covered Entity of such breach in accordance with the requirements of section 13402 of HITECH (42 U.S.C. 17932(b) and the provisions of this Section of the Contract.
B. Such notification shall be provided by the Business Associate to the Covered Entity without unreasonable delay, and in no case later than 30 days after the breach is discovered by the Business Associate, except as otherwise instructed in writing by a law enforcement official pursuant to section 13402 (g) of HITECH (42 U.S.C. 17932(g)) . A breach is considered discovered as of the first day on which it is, or reasonably should have been, known to the Business Associate. The notification shall include the identification and last known address, phone number and email address of each individual (or the next of kin of the individual if the individual is deceased) whose unsecured protected health information has been, or is reasonably believed by the Business Associate to have been, accessed, acquired, or disclosed during such breach.
C. The Business Associate agrees to include in the notification to the Covered Entity at least the following information:
    1. A brief description of what happened, including the date of the breach and the date of the discovery of the breach, if known.

    2. A description of the types of unsecured protected health information that were involved in the breach (such as full name, Social Security number, date of birth, home address, account number, or disability code).

    3. The steps the Business Associate recommends that individuals take to protect themselves from potential harm resulting from the breach.

    4. A detailed description of what the Business Associate is doing to investigate the breach, to mitigate losses, and to protect against any further breaches.

    5. Whether a law enforcement official has advised either verbally or in writing the Business Associate that he or she has determined that notification or notice to

individuals or the posting required under section 13402 of the HITECH Act would impede a criminal investigation or cause damage to national security and; if so, include contact information for said official.

D. Business Associate agrees to provide appropriate staffing and have established procedures to ensure that individuals informed by the Covered Entity of a breach by the Business Associate have the opportunity to ask questions and contact the Business Associate for additional information regarding the breach. Such procedures shall include a toll-free telephone number, an e-mail address, a posting on its Web site and a postal address. Business Associate agrees to include in the notification of a breach by the Business Associate to the Covered Entity, a written description of the procedures that have been established to meet these requirements. Costs of such contact procedures will be borne by the Contractor.

E. Business Associate agrees that, in the event of a breach, it has the burden to demonstrate that it has complied with all notifications requirements set forth above, including evidence demonstrating the necessity of a delay in notification to the Covered Entity.

(i) Permitted Uses and Disclosure by Business Associate.

(1) General Use and Disclosure Provisions Except as otherwise limited in this Section of the Contract, Business Associate may use or disclose PHI to perform functions, activities, or services for, or on behalf of, Covered Entity as specified in this Contract, provided that such use or disclosure would not violate the Privacy Rule if done by Covered Entity or the minimum necessary policies and procedures of the Covered Entity.

(2) Specific Use and Disclosure Provisions

(A) Except as otherwise limited in this Section of the Contract, Business Associate may use PHI for the proper management and administration of Business Associate or to carry out the legal responsibilities of Business Associate.

(B) Except as otherwise limited in this Section of the Contract, Business Associate may disclose PHI for the proper management and administration of Business Associate, provided that disclosures are Required by Law, or Business Associate obtains reasonable assurances from the person to whom the information is disclosed that it will remain confidential and used or further disclosed only as Required by Law or for the purpose for which it was disclosed to the person, and the person notifies Business Associate of any instances of which it is aware in which the confidentiality of the information has been breached.

(C) Except as otherwise limited in this Section of the Contract, Business Associate may use PHI to provide Data Aggregation services to Covered Entity as permitted by 45 C.F.R. § 164.504(e)(2)(i)(B).

(j) Obligations of Covered Entity.

(1) Covered Entity shall notify Business Associate of any limitations in its notice of privacy practices of Covered Entity, in accordance with 45 C.F.R. § 164.520, or to the extent that such limitation may affect Business Associate's use or disclosure of PHI.

(2) Covered Entity shall notify Business Associate of any changes in, or revocation of, permission by Individual to use or disclose PHI, to the extent that such changes may affect Business Associate's use or disclosure of PHI.

(3) Covered Entity shall notify Business Associate of any restriction to the use or disclosure of PHI that Covered Entity has agreed to in accordance with 45 C.F.R. § 164.522, to the extent that such restriction may affect Business Associate's use or disclosure of PHI.

(k) Permissible Requests by Covered Entity. Covered Entity shall not request Business Associate to use or disclose PHI in any manner that would not be permissible under the Privacy Rule if done by the Covered Entity, except that Business Associate may use and disclose PHI for data aggregation, and management and administrative activities of Business Associate, as permitted under this Section of the Contract.

(l) Term and Termination.

(1) Term. The Term of this Section of the Contract shall be effective as of the date the Contract is effective and shall terminate when the information collected in accordance with clause h. (10) of this Section of the Contract is provided to the Covered Entity and all of the PHI provided by Covered Entity to Business Associate, or created or received by Business Associate on behalf of Covered Entity, is destroyed or returned to Covered Entity, or, if it is infeasible to return or destroy PHI, protections are extended to such information, in accordance with the termination provisions in this Section.

(2) Termination for Cause Upon Covered Entity's knowledge of a material breach by Business Associate, Covered Entity shall either:

(A) Provide an opportunity for Business Associate to cure the breach or end the violation and terminate the Contract if Business Associate does not cure the breach or end the violation within the time specified by the Covered Entity; or

(B) Immediately terminate the Contract if Business Associate has breached a material term of this Section of the Contract and cure is not possible; or

(C) If neither termination nor cure is feasible, Covered Entity shall report the violation to the Secretary.

(3) Effect of Termination

(A) Except as provided in (l)(2) of this Section of the Contract, upon termination of this Contract, for any reason, Business Associate shall return or destroy all PHI received from Covered Entity, or created or received by Business Associate on behalf of Covered Entity. Business Associate shall also provide the information collected in accordance with clause h. (10) of this Section of the Contract to the Covered Entity

within ten business days of the notice of termination. This provision shall apply to PHI that is in the possession of subcontractors or agents of Business Associate. Business Associate shall retain no copies of the PHI.

(B) In the event that Business Associate determines that returning or destroying the PHI is infeasible, Business Associate shall provide to Covered Entity notification of the conditions that make return or destruction infeasible. Upon documentation by Business Associate that return or destruction of PHI is infeasible, Business Associate shall extend the protections of this Section of the Contract to such PHI and limit further uses and disclosures of PHI to those purposes that make return or destruction infeasible, for as long as Business Associate maintains such PHI. Infeasibility of the return or destruction of PHI includes, but is not limited to, requirements under state or federal law that the Business Associate maintains or preserves the PHI or copies thereof.

(m) Miscellaneous Provisions.

(1) Regulatory References. A reference in this Section of the Contract to a section in the Privacy Rule means the section as in effect or as amended.

(2) Amendment. The Parties agree to take such action as in necessary to amend this Section of the Contract from time to time as is necessary for Covered Entity to comply with requirements of the Privacy Rule and the Health Insurance Portability and Accountability Act of 1996, Pub. L. No. 104-191.

(3) Survival. The respective rights and obligations of Business Associate shall survive the termination of this Contract.

(4) Effect on Contract. Except as specifically required to implement the purposes of this Section of the Contract, all other terms of the Contract shall remain in force and effect.

(5) Construction. This Section of the Contract shall be construed as broadly as necessary to implement and comply with the Privacy Standard. Any ambiguity in this Section of the Contract shall be resolved in favor of a meaning that complies, and is consistent with, the Privacy Standard.

(6) Disclaimer. Covered Entity makes no warranty or representation that compliance with this Section of the Contract will be adequate or satisfactory for Business Associate's own purposes. Covered Entity shall not be liable to Business Associate for any claim, civil or criminal penalty, loss or damage related to or arising from the unauthorized use or disclosure of PHI by Business Associate or any of its officers, directors, employees, contractors or agents, or any third party to whom Business Associate has disclosed PHI contrary to the provisions of this Contract or applicable law. Business Associate is solely responsible for all decisions made, and actions taken, by Business Associate regarding the safeguarding, use and disclosure of PHI within its possession, custody or control.

(7) Indemnification. The Business Associate shall indemnify and hold the Covered Entity harmless from and against any and all claims, liabilities, judgments, fines, assessments, penalties, awards and any statutory damages that may be imposed or assessed pursuant to HIPAA, as amended or the

HITECH Act, including, without limitation, attorney's fees, expert witness fees, costs of investigation, litigation or dispute resolution, and costs awarded thereunder, relating to or arising out of any violation by the Business Associate and its agents, including subcontractors, of any obligation of Business Associate and its agents, including subcontractors, under this section of the contract, under HIPAA, the HITECH Act, the Privacy Rule and the Security Rule.

Notice to Executive Branch State Contractors and Prospective State Contractors of Campaign Contribution and Solicitation Limitations

This notice is provided under the authority of Connecticut General Statutes §9-612 (f) (2) and is for the purpose of informing state contractors and prospective state contractors of the following law (italicized words are defined on the reverse side of this page).

CAMPAIGN CONTRIBUTION AND SOLICITATION LIMITATIONS

No *state contractor, prospective state contractor, principal of a state contractor or principal of a prospective state contractor*, with regard to a *state contract* or *state contract solicitation* with or from a state agency in the executive branch or a quasi-public agency or a holder, or principal of a holder, of a valid prequalification certificate, shall make a contribution to (i) an exploratory committee or candidate committee established by a candidate for nomination or election to the office of Governor, Lieutenant Governor, Attorney General, State Comptroller, Secretary of the State or State Treasurer, (ii) a political committee authorized to make contributions or expenditures to or for the benefit of such candidates, or (iii) a party committee (which includes town committees).

In addition, no holder or principal of a holder of a valid prequalification certificate, shall make a contribution to (i) an exploratory committee or candidate committee established by a candidate for nomination or election to the office of State senator or State representative, (ii) a political committee authorized to make contributions or expenditures to or for the benefit of such candidates, or (iii) a party committee.

On and after January 1, 2011, no state contractor, prospective state contractor, principal of a state contractor or principal of a prospective state contractor, with regard to a state contract or state contract solicitation with or from a state agency in the executive branch or a quasi-public agency or a holder, or principal of a holder of a valid prequalification certificate, shall **knowingly** *solicit* contributions from the state contractor's or prospective state contractor's employees or from a *subcontractor* or *principals of the subcontractor* on behalf of (i) an exploratory committee or candidate committee established by a candidate for nomination or election to the office of Governor, Lieutenant Governor, Attorney General, State Comptroller, Secretary of the State or State Treasurer, (ii) a political committee authorized to make contributions or expenditures to or for the benefit of such candidates, or (iii) a party committee.

DUTY TO INFORM

State contractors and prospective state contractors are required to inform their principals of the above prohibitions, as applicable, and the possible penalties and other consequences of any violation thereof.

PENALTIES FOR VIOLATIONS

Contributions or solicitations of contributions made in violation of the above prohibitions may result in the following civil and criminal penalties:

Civil penalties—Up to $2,000 or twice the amount of the prohibited contribution, whichever is greater, against a principal or a contractor. Any state contractor or prospective state contractor which fails to make reasonable efforts to comply with the provisions requiring notice to its principals of these prohibitions and the possible consequences of their violations may also be subject to civil penalties of up to $2,000 or twice the amount of the prohibited contributions made by their principals.

Criminal penalties—Any knowing and willful violation of the prohibition is a Class D felony, which may subject the violator to imprisonment of not more than 5 years, or not more than $5,000 in fines, or both.

CONTRACT CONSEQUENCES

In the case of a state contractor, contributions made or solicited in violation of the above prohibitions may result in the contract being voided.

In the case of a prospective state contractor, contributions made or solicited in violation of the above prohibitions shall result in the contract described in the state contract solicitation not being awarded to the prospective state contractor, unless the State Elections Enforcement Commission determines that mitigating circumstances exist concerning such violation.

The State shall not award any other state contract to anyone found in violation of the above prohibitions for a period of one year after the election for which such contribution is made or solicited, unless the State Elections Enforcement Commission determines that mitigating circumstances exist concerning such violation.

Additional information may be found on the website of the State Elections Enforcement Commission, www.ct.gov/seec. Click on the link to "Lobbyist/Contractor Limitations."

DEFINITIONS

"State contractor" means a person, business entity or nonprofit organization that enters into a state contract. Such person, business entity or nonprofit organization shall be deemed to be a state contractor until December thirty-first of the year in which such contract terminates. "State contractor" does not include a municipality or any other political subdivision of the state, including any entities or associations duly created by the municipality or political subdivision exclusively amongst themselves to further any purpose authorized by statute or charter, or an employee in the executive or legislative branch of state government or a quasi-public agency, whether in the classified or unclassified service and full or part-time, and only in such person's capacity as a state or quasi-public agency employee.

"Prospective state contractor" means a person, business entity or nonprofit organization that (i) submits a response to a state contract solicitation by the state, a state agency or a quasi-public agency, or a proposal in response to a request for proposals by the state, a state agency or a quasi-public agency, until the contract has been entered into, or (ii) holds a valid prequalification certificate issued by the Commissioner of Administrative Services under section 4a-100. "Prospective state contractor" does not include a municipality or any other political subdivision of the state, including any entities or associations duly created by the municipality or political subdivision exclusively amongst themselves to further any purpose authorized by statute or charter, or an employee in the executive or legislative branch of state government or a quasi-public agency, whether in the classified or unclassified service and full or part-time, and only in such person's capacity as a state or quasi-public agency employee.

"Principal of a state contractor or prospective state contractor" means (i) any individual who is a member of the board of directors of, or has an ownership interest of five per cent or more in, a state contractor or prospective state contractor, which is a business entity, except for an individual who is a member of the board of directors of a nonprofit organization**,** (ii) an individual who is employed by a state contractor or prospective state contractor, which is a business entity, as president, treasurer or executive vice president, (iii) an individual who is the chief executive officer of a state contractor or prospective state contractor, which is not a business entity, or if a state contractor or prospective state contractor has no such officer, then the officer who duly possesses comparable powers and duties, (iv) an officer or an employee of any state contractor or prospective state contractor who has *managerial or discretionary responsibilities with respect to a state contract,* (v) the spouse or a *dependent child* who is eighteen years of age or older of an individual described in this subparagraph, or (vi) a political committee established or controlled by an individual described in this subparagraph or the business entity or nonprofit organization that is the state contractor or prospective state contractor.

"State contract" means an agreement or contract with the state or any state agency or any quasi-public agency, let through a procurement process or otherwise, having a value of fifty thousand dollars or more, or a combination or series of such agreements or contracts having a value of one hundred thousand dollars or more in a calendar year, for (i) the rendition of services, (ii) the furnishing of any goods, material, supplies, equipment or any items of any kind, (iii) the construction, alteration or repair of any public building or public work, (iv) the acquisition, sale or lease of any land or building, (v) a licensing arrangement, or (vi) a grant, loan or loan guarantee. "State contract" does not include any agreement or contract with the state, any state agency or any quasi-public agency that is exclusively federally funded, an education loan, a loan to an individual for other than commercial purposes or any agreement or contract between the state or any state agency and the United States Department of the Navy or the United States Department of Defense.

"State contract solicitation" means a request by a state agency or quasi-public agency, in whatever form issued, including, but not limited to, an invitation to bid, request for proposals, request for information or request for quotes, inviting bids, quotes or other types of submittals, through a competitive procurement process or another process authorized by law waiving competitive procurement.

"Managerial or discretionary responsibilities with respect to a state contract" means having direct, extensive and substantive responsibilities with respect to the negotiation of the state contract and not peripheral, clerical or ministerial responsibilities.

"Dependent child" means a child residing in an individual's household who may legally be claimed as a dependent on the federal income tax of such individual.

"Solicit" means (A) requesting that a contribution be made, (B) participating in any fundraising activities for a candidate committee, exploratory committee, political committee or party committee, including, but not limited to, forwarding tickets to potential contributors, receiving contributions for transmission to any such committee, serving on the committee that is hosting a fundraising event, introducing the candidate or making other public remarks at a fundraising event, being honored or otherwise recognized at a fundraising event, or bundling contributions, (C) serving as chairperson, treasurer or deputy treasurer of any such committee, or (D) establishing a political committee for the sole purpose of soliciting or receiving contributions for any committee. Solicit does not include: (i) making a contribution that is otherwise permitted by Chapter 155 of the Connecticut General Statutes; (ii) informing any person of a position taken by a candidate for public office or a public official, (iii) notifying the person of any activities of, or contact information for, any candidate for public office; or (iv) serving as a member in any party committee or as an officer of such committee that is not otherwise prohibited in this section.

"Subcontractor" means any person, business entity or nonprofit organization that contracts to perform part or all of the obligations of a state contractor's state contract. Such person, business entity or nonprofit organization shall be deemed to be a subcontractor until December thirty first of the year in which the subcontract terminates. "Subcontractor" does not include (i) a municipality or any other political subdivision of the state, including any entities or associations duly created by the municipality or political subdivision exclusively amongst themselves to further any purpose authorized by statute or charter, or (ii) an employee in the executive or legislative branch of state government or a quasi-public agency, whether in the classified or unclassified service and full or part-time, and only in such person's capacity as a state or quasi-public agency employee.

"Principal of a subcontractor" means (i) any individual who is a member of the board of directors of, or has an ownership interest of five per cent or more in, a subcontractor, which is a business entity, except for an individual who is a member of the board of directors of a nonprofit organization, (ii) an individual who is employed by a subcontractor, which is a business entity, as president, treasurer or executive vice president, (iii) an individual who is the chief executive officer of a subcontractor, which is not a business entity, or if a subcontractor has no such officer, then the officer who duly possesses comparable powers and duties, (iv) an officer or an employee of any subcontractor who has managerial or discretionary responsibilities with respect to a subcontract with a state contractor, (v) the spouse or a dependent child who is eighteen years of age or older of an individual described in this subparagraph, or (vi) a political committee established or controlled by an individual described in this subparagraph or the business entity or nonprofit organization that is the subcontractor.

EXHIBIT D

State Wages and Other Related Information

Please refer to the Department of Labor website for the latest updates, annual adjusted wage rate increases, certified payroll forms and applicable statutes.
http://www.ctdol.state.ct.us/wgwkstnd/prevailwage.htm

Prevailing Wage Law Poster Language

THIS IS A PUBLIC WORKS PROJECT Covered by the
PREVAILING WAGE LAW CT General Statutes Section 31-53

If you have QUESTIONS regarding your wages CALL (860) 263-6790

Section 31-55 of the CT State Statutes requires every contractor or subcontractor performing work for the state to post in a prominent place the prevailing wages as determined by the Labor Commissioner.

Informational Bulletin

THE 10-HOUR OSHA CONSTRUCTION SAFETY AND HEALTH COURSE (applicable to public building contracts entered into on or after July 1, 2007, where the total cost of all work to be performed is at least $100,000)

(1) This requirement was created by Public Act No. 06-175, which is codified in Section 31-53b of the Connecticut General Statutes (pertaining to the prevailing wage statutes);

(2) The course is required for public building construction contracts (projects funded in whole or in part by the state or any political subdivision of the state) entered into on or after July 1, 2007;

(3) It is required of private employees (not state or municipal employees) and apprentices who perform manual labor for a general contractor or subcontractor on a public building project where the total cost of all work to be performed is at least $100,000;

(4) The ten-hour construction course pertains to the ten-hour Outreach Course conducted in accordance with federal OSHA Training Institute standards, and, for telecommunications workers, a ten-hour training course conducted in accordance with federal OSHA standard, 29 CFR 1910.268;

(5) The internet website for the federal OSHA Training Institute is http://www.osha.gov/fso/ote/training/edcenters/fact_sheet.html;

(6) The statutory language leaves it to the contractor and its employees to determine who pays for the cost of the ten-hour Outreach Course;

(7) Within 30 days of receiving a contract award, a general contractor must furnish proof to the Labor Commissioner that all employees and apprentices performing manual labor on the project will have completed such a course;

(8) Proof of completion may be demonstrated through either: (a) the presentation of a bona fide student course completion card issued by the federal OSHA Training Institute; or (2) the presentation of documentation provided to an employee by a trainer certified by the Institute pending the actual issuance of the completion card;

(9) Any card with an issuance date more than 5 years prior to the commencement date of the construction project shall not constitute proof of compliance;

(10) Each employer shall affix a copy of the construction safety course completion card to the certified payroll submitted to the contracting agency in accordance with Conn. Gen. Stat. § 31-53(f) on which such employee's name first appears;

(11) Any employee found to be in non-compliance shall be subject to removal from the worksite if such employee does not provide satisfactory proof of course completion to the Labor Commissioner by the fifteenth day after the date the employee is determined to be in noncompliance;

(12) Any such employee who is determined to be in noncompliance may continue to work on a public building construction project for a maximum of fourteen consecutive calendar days while bringing his or her status into compliance;

(13) The Labor Commissioner may make complaint to the prosecuting authorities regarding any employer or agent of the employer, or officer or agent of the corporation who files a false certified payroll with respect to the status of an employee who is performing manual labor on a public building construction project;

(14) The statute provides the minimum standards required for the completion of a safety course by manual laborers on public construction contracts; any contractor can exceed these minimum requirements; and

(15) Regulations clarifying the statute are currently in the regulatory process, and shall be posted on the CTDOL website as soon as they are adopted in final form.

(16) Any questions regarding this statute may be directed to the Wage and Workplace Standards Division of the Connecticut Labor Department via the internet website of http://www.ctdol.state.ct.us/wgwkstnd/wgemenu.htm; or by telephone at (860)263-6790.

THE ABOVE INFORMATION IS PROVIDED EXCLUSIVELY AS AN EDUCATIONAL RESOURCE, AND IS NOT INTENDED AS A SUBSTITUTE FOR LEGAL INTERPRETATIONS WHICH MAY ULTMATELY ARISE CONCERNIG THE CONSTRUCTION OF THE STATUTE OR THE REGULATIONS.

November 29, 2006

Notice

To All Mason Contractors and Interested Parties Regarding Construction Pursuant to Section 31-53 of the Connecticut General Statutes (Prevailing Wage)

The Connecticut Labor Department Wage and Workplace Standards Division is empowered to enforce the prevailing wage rates on projects covered by the above referenced statute.
Over the past few years the Division has withheld enforcement of the rate in effect for workers who operate a forklift on a prevailing wage rate project due to a potential jurisdictional dispute. The rate listed in the schedules and in our Occupational Bulletin (see enclosed) has been as follows:

Forklift Operator:

- Laborers (Group 4) Mason Tenders - operates forklift solely to assist a mason to a maximum height of nine feet only.

- Power Equipment Operator (Group 9) - operates forklift to assist any trade and to assist a mason to a height over nine feet.

The U.S. Labor Department conducted a survey of rates in Connecticut but it has not been published and the rate in effect remains as outlined in the above Occupational Bulletin.

Since this is a classification matter and not one of jurisdiction, effective January 1, 2007 the Connecticut Labor Department will enforce the rate on each schedule in accordance with our statutory authority.

Your cooperation in filing appropriate and accurate certified payrolls is appreciated.

CONNECTICUT DEPARTMENT OF LABOR
WAGE AND WORKPLACE STANDARDS DIVISION

CONTRACTORS WAGE CERTIFICATION FORM
Construction Manager at Risk/General Contractor/Prime Contractor

I, _____ of _____
Officer, Owner, Authorized Rep. Company Name

do hereby certify that the _____
Company Name

_____
Street

_____
City

and all of its subcontractors will pay all workers on the

_____
Project Name and Number

_____
Street and City

the wages as listed in the schedule of prevailing rates required for such project (a copy of which is attached hereto).

_____
Signed

Subscribed and sworn to before me this_____ day of _____, _____.

_____
Notary Public

Return to: Connecticut Department of Labor
Wage & Workplace Standards Division
200 Folly Brook Blvd.
Wethersfield, CT 06109

Rate Schedule Issued (Date):_____

Information Bulletin
Occupational Classifications

The Connecticut Department of Labor has the responsibility to properly determine "job classification" on prevailing wage projects covered under C.G.S. Section 31-53(d).

Note: This information is intended to provide a sample of some occupational classifications for guidance purposes only. It is not an all-inclusive list of each occupation's duties. This list is being provided only to highlight some areas where a contractor may be unclear regarding the proper classification. If unsure, the employer should seek guidelines for CTDOL.

Below are additional clarifications of specific job duties performed for certain classifications:

ASBESTOS WORKERS

Applies all insulating materials, protective coverings, coatings and finishes to all types of mechanical systems.

ASBESTOS INSULATOR

Handle, install apply, fabricate, distribute, prepare, alter, repair, dismantle, heat and frost insulation, including penetration and fire stopping work on all penetration fire stop systems.

BOILERMAKERS

Erects hydro plants, incomplete vessels, steel stacks, storage tanks for water, fuel, etc. Builds incomplete boilers, repairs heat exchanges and steam generators.

BRICKLAYERS, CEMENT MASONS, CEMENT FINISHERS, MARBLE MASONS, PLASTERERS, STONE MASONS, PLASTERERS. STONE MASONS, TERRAZZO WORKERS, TILE SETTERS

Lays building materials such as brick, structural tile and concrete cinder, glass, gypsum, terra cotta block. Cuts, tools and sets marble, sets stone, finishes concrete, applies decorative steel, aluminum and plastic tile, applies cements, sand, pigment and marble chips to floors, stairways, etc.

CARPENTERS, MILLWRIGHTS. PILEDRIVERMEN. LATHERS. RESILEINT FLOOR LAYERS, DOCK BUILDERS, DIKERS, DIVER TENDERS

Constructs, erects, installs and repairs structures and fixtures of wood, plywood and wallboard. Installs, assembles, dismantles, moves industrial machinery. Drives piling into ground to provide foundations for structures such as buildings and bridges, retaining walls for earth embankments, such as cofferdams. Fastens wooden, metal or rockboard lath to walls, ceilings and partitions of buildings, acoustical tile layer, concrete form builder. Applies firestopping materials on fire resistive joint systems only. Installation of curtain/window walls only where attached to wood or metal studs. Installation of insulated material of all types whether blown, nailed or attached in other ways to walls, ceilings and floors of buildings. Assembly and installation of modular furniture/furniture systems. Free-standing furniture is not covered. This includes free standing:

student chairs, study top desks, book box desks, computer furniture, dictionary stand, atlas stand, wood shelving, two-position information access station, file cabinets, storage cabinets, tables, etc.

LABORER, CLEANING

• The clean up of any construction debris and the general (heavy/light) cleaning, including sweeping, wash down, mopping, wiping of the construction facility and its furniture, washing, polishing, and dusting.

DELIVERY PERSONNEL

• If delivery of supplies/building materials is to one common point and stockpiled there, prevailing wages are not required. If the delivery personnel are involved in the distribution of the material to multiple locations within the construction site then they would have to be paid prevailing wages for the type of work performed: laborer, equipment operator, electrician, ironworker, plumber, etc.

• An example of this would be where delivery of drywall is made to a building and the delivery personnel distribute the drywall from one "stockpile" location to further sub-locations on each floor. Distribution of material around a construction site is the job of a laborer or tradesman, and not a delivery personnel.

ELECTRICIANS

Install, erect, maintenance, alteration or repair of any wire, cable, conduit, etc., which generates, transforms, transmits or uses electrical energy for light, heat, power or other purposes, including the Installation or maintenance of telecommunication, LAN wiring or computer equipment, and low voltage wiring. *License required per Connecticut General Statutes: E-1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9.

ELEVATOR CONSTRUCTORS

Install, erect, maintenance and repair of all types of elevators, escalators, dumb waiters and moving walks. ***License required by Connecticut General Statutes: R-1, 2, 5, 6.**

FORK LIFT OPERATOR

Laborers Group 4) Mason Tenders - operates forklift solely to assist a mason to a maximum height of nine (9) feet only.

Power Equipment Operator Group 9 - operates forklift to assist any trade, and to assist a mason to a height over nine (9) feet.

GLAZIERS

Glazing wood and metal sash, doors, partitions, and 2 story aluminum storefronts. Installs glass windows, skylights, store fronts and display cases or surfaces such as building fronts, interior walls, ceilings and table tops and metal store fronts. Installation of aluminum window walls and curtain walls is the "joint" work of glaziers and ironworkers, which require equal composite workforce.

□ IRONWORKERS

Erection, installation and placement of structural steel, precast concrete, miscellaneous iron, ornamental iron, metal curtain wall, rigging and reinforcing steel. Handling, sorting, and installation of reinforcing steel (rebar). Metal bridge rail (traffic), metal bridge handrail, and decorative security fence installation. Installation of aluminum window walls and curtain walls is the "joint" work of glaziers and ironworkers which require equal composite workforce.

□ INSULATOR

• Installing fire stopping systems/materials for "Penetration Firestop Systems": transit to cables, electrical conduits, insulated pipes, sprinkler pipe penetrations, ductwork behind radiation, electrical cable trays, fire rated pipe penetrations, natural polypropylene, HVAC ducts, plumbing bare metal, telephone and communication wires, and boiler room ceilings.

□ LABORERS

Acetylene burners, asphalt rakers, chain saw operators, concrete and power buggy operator, concrete saw operator, fence and guard rail erector (except metal bridge rail (traffic), decorative security fence (non-metal).

installation.), hand operated concrete vibrator operator, mason tenders, pipelayers (installation of storm drainage or sewage lines on the street only), pneumatic drill operator, pneumatic gas and electric drill operator, powermen and wagon drill operator, air track operator, block paver, curb setters, blasters, concrete spreaders.

□ PAINTERS

Maintenance, preparation, cleaning, blasting (water and sand, etc.), painting or application of any protective coatings of every description on all bridges and appurtenances of highways, roadways, and railroads. Painting, decorating, hardwood finishing, paper hanging, sign writing, scenic art work and drywall hhg for any and all types of building and residential work.

□ LEAD PAINT REMOVAL

• Painter's Rate 1. Removal of lead paint from bridges. 2. Removal of lead paint as preparation of any surface to be repainted. 3. Where removal is on a Demolition project prior to reconstruction. • Laborer's Rate 1. Removal of lead paint from any surface NOT to be repainted. 2. Where removal is on a TOTAL Demolition project only.

□ PLUMBERS AND PIPEFITTERS

Installation, repair, replacement, alteration or maintenance of all plumbing, heating, cooling and piping. ***License required per Connecticut General Statutes: P-1,2,6,7,8,9 J1,2,3,4 SP-1,2 S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4.**

POWER EQUIPMENT OPERATORS

Operates several types of power construction equipment such as compressors, pumps, hoists, derricks, cranes, shovels, tractors, scrapers or motor graders, etc. Repairs and maintains equipment. ***License required, crane operators only, per Connecticut General Statutes.**

ROOFERS

Covers roofs with composition shingles or sheets, wood shingles, slate or asphalt and gravel to waterproof roofs, including preparation of surface. (demolition or removal of any type of roofing and or clean-up of any and all areas where a roof is to be relaid.)

SHEETMETAL WORKERS

Fabricate, assembles, installs and repairs sheetmetal products and equipment in such areas as ventilation, air-conditioning, warm air heating, restaurant equipment, architectural sheet metal work, sheetmetal roofing, and aluminum gutters. Fabrication, handling, assembling, erecting, altering, repairing, etc. of coated metal material panels and composite metal material panels when used on building exteriors and interiors as soffits, facia, louvers, partitions, canopies, cornice, column covers, awnings, beam covers, cladding, sun shades, lighting troughs, spires, ornamental roofing, metal ceilings, mansards, copings, ornamental and ventilation hoods, vertical and horizontal siding panels, trim, etc. The sheet metal classification also applies to the vast variety of coated metal material panels and composite metal material panels that have evolved over the years as an alternative to conventional ferrous and non-ferrous metals like steel, iron, tin, copper, brass, bronze, aluminum, etc. Fabrication, handling, assembling, erecting, altering, repairing, etc. of architectural metal roof, standing seam roof, composite metal roof, metal and composite bathroom/toilet partitions, aluminum gutters, metal and composite lockers and shelving, kitchen equipment, and walk-in coolers. To include testing and air –balancing ancillary to installation and construction.

SPRINKLER FITTERS

Installation, alteration, maintenance and repair of fire protection sprinkler systems. ***License required per Connecticut General Statutes: F-1, 2, 3, 4.**

TILE MARBLE AND TERRAZZO FINISHERS

Assists and tends the tile setter, marble mason and terrazzo worker in the performance of their duties.

TRUCK DRIVERS

~How to pay truck drivers delivering asphalt is under REVISION~

Truck Drivers are requires to be paid prevailing wage for time spent "working" directly on the site. These drivers remain covered by the prevailing wage for any time spent transporting between the actual construction location and facilities (such as fabrication, plants, mobile factories, batch plant, borrow pits, job headquarters, tool yards, etc.) dedicated exclusively, or nearly so, to performance

of the contract or project, which are so located in proximity to the actual construction location that it is reasonable to include them. ***License required, drivers only, per Connecticut General Statutes**.

For example:

• Material men and deliverymen are not covered under prevailing wage as long as they are not directly involved in the construction process. If, they unload the material, they would then be covered by prevailing wage for the classification they are performing work in: laborer, equipment operator, etc.
• Hauling material off site is not covered provided they are not dumping it at a location outlined above.
• Driving a truck on site and moving equipment or materials on site would be considered covered work, as this is part of the construction process.

 Any questions regarding the proper classification should be directed to:

Public Contract Compliance Unit
Wage and Workplace Standards Division
Connecticut Department of Labor
200 Folly Brook Blvd, Wethersfield, CT 06109
(860) 263-6543.

Connecticut Department of Labor
Wage and Workplace Standards Division
FOOTNOTES

 Please Note: If the "Benefits" listed on the schedule for the following occupations includes a letter(s) (+ a or + a+b for instance), refer to the information below.

Benefits to be paid at the appropriate prevailing wage rate for the listed occupation.

If the "Benefits" section for the occupation lists only a dollar amount, disregard the information below.

Bricklayers, Cement Masons, Cement Finishers, Concrete Finishers, Stone Masons
(Building Construction) and (Residential- Hartford, Middlesex, New Haven, New London and Tolland Counties)

a. Paid Holiday: Employees shall receive 4 hours for Christmas Eve holiday provided the employee works the regularly scheduled day before and after the holiday. Employers may schedule work on Christmas Eve and employees shall receive pay for actual hours worked in addition to holiday pay.

Elevator Constructors: Mechanics

a. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day, Christmas Day, plus the Friday after Thanksgiving.

b. Vacation: Employer contributes 8% of basic hourly rate for 5 years or more of service or 6% of basic hourly rate for 6 months to 5 years of service as vacation pay credit.

Glaziers

a. Paid Holidays: Labor Day and Christmas Day.

Power Equipment Operators
(Heavy and Highway Construction & Building Construction)

a. Paid Holidays: New Year's Day, Good Friday, Memorial day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day, provided the employee works 3 days during the week in which the holiday falls, if scheduled, and if scheduled, the working day before and the working day after the holiday. Holidays falling on Saturday may be observed on Saturday, or if the employer so elects, on the preceding Friday.

Ironworkers

a. Paid Holiday: Labor Day provided employee has been on the payroll for the 5 consecutive work days prior to Labor Day.

Laborers (Tunnel Construction)

a. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. No employee shall be eligible for holiday pay when he

fails, without cause, to work the regular work day preceding the holiday or the regular work day following the holiday.

Roofers

a. Paid Holidays: July 4th, Labor Day, and Christmas Day provided the employee is employed 15 days prior to the holiday.

Sprinkler Fitters

a. Paid Holidays: Memorial Day, July 4th, Labor Day, Thanksgiving Day and Christmas Day, provided the employee has been in the employment of a contractor 20 working days prior to any such paid holiday.

Truck Drivers

(Heavy and Highway Construction & Building Construction)

a. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas day, and Good Friday, provided the employee has at least 31 calendar days of service and works the last scheduled day before and the first scheduled day after the holiday, unless excused.

Rev. 7/1/19

SEE BELOW FOR STATE WAGE RATES

INSERT STATE WAGES HERE

Minimum Rates and Classifications for Building Construction

ID# 20-15430

Connecticut Department of Labor
Wage and Workplace Standards

By virtue of the authority vested in the Labor Commissioner under provisions of Section 31-53 of the General Statutes of Connecticut, as amended, the following are declared to be the prevailing rates and welfare payments and will apply only where the contract is advertised for bid within 20 days of the date on which the rates are established. Any contractor or subcontractor not obligated by agreement to pay

Project Number: #115-121 Project Town: Putnam
State#: #115-121 FAP#: Putnam
Project: Construction of Putnam CT DOT Repair & Maintenance Facility (Putnam)

CLASSIFICATION	Hourly	Benefits
1b) Asbestos/Toxic Waste Removal Laborers: Asbestos removal and encapsulation (except its removal from mechanical systems which are not to be scrapped), toxic waste removers, blasters.**See Laborers Group 7**		
1c) Asbestos Worker/Heat and Frost Insulator	40.21	30.99
2) Boilermaker	38.34	26.01
3a) Bricklayer, Cement Mason, Concrete Finisher (including caulking), Stone Masons	35.71	33.31 + a
3b) Tile Setter	34.9	25.87
3c) Terrazzo Mechanics and Marble Setters	31.69	22.35
3d) Tile, Marble & Terrazzo Finishers	26.7	21.75
3e) Plasterer	33.48	32.06
------LABORERS------		
4) Group 1: Laborers (common or general), acetylene burners, concrete specialists, wrecking laborers, fire watchers.	31.0	22.15
4a) Group 2: Mortar mixers, plaster tender, power buggy operators, powdermen, fireproofer/mixer/nozzleman (Person running mixer and spraying fireproof only).	31.25	22.15

As of: September 9, 2020

4b) Group 3: Jackhammer operators/pavement breaker, mason tender (brick), mason tender (cement/concrete), forklift operators and forklift operators (masonry).	31.5	22.15
4c) **Group 4: Pipelayers (Installation of water, storm drainage or sewage lines outside of the building line with P6, P7 license) (the pipelayer rate shall apply only to one or two employees of the total crew who primary task is to actually perform the mating of pipe sections) P6 and P7 rate is $26.80.	32.0	22.15
4d) Group 5: Air track operator, sand blaster and hydraulic drills.	31.75	22.15
4e) Group 6: Blasters, nuclear and toxic waste removal.	34.0	22.15
4f) Group 7: Asbestos/lead removal and encapsulation (except it's removal from mechanical systems which are not to be scrapped).	32.0	22.15
4g) Group 8: Bottom men on open air caisson, cylindrical work and boring crew.	29.28	22.15
4h) Group 9: Top men on open air caisson, cylindrical work and boring crew.	28.74	22.15
4i) Group 10: Traffic Control Signalman	18.0	22.15
5) Carpenter, Acoustical Ceiling Installation, Soft Floor/Carpet Laying, Metal Stud Installation, Form Work and Scaffold Building, Drywall Hanging, Modular-Furniture Systems Installers, Lathers, Piledrivers, Resilient Floor Layers.	34.53	25.64
5a) Millwrights	34.94	26.19
6) Electrical Worker (including low voltage wiring) (Trade License required: E1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9)	40.25	29.17+3% of gross wage
7a) Elevator Mechanic (Trade License required: R-1,2,5,6)	55.12	34.765+a+b
-----LINE CONSTRUCTION----		
Groundman	26.5	6.5% + 9.00
Linemen/Cable Splicer	48.19	6.5% + 22.00
8) Glazier (Trade License required: FG-1,2)	39.18	22.55 + a

As of: September 9, 2020

9) Ironworker, Ornamental, Reinforcing, Structural, and Precast Concrete Erection	36.67	37.62 + a
----OPERATORS----		
Group 1: Crane handling or erecting structural steel or stone, hoisting engineer 2 drums or over, front end loader (7 cubic yards or over), work boat 26 ft. and over and Tunnel Boring Machines. (Trade License Required)	42.45	25.30 + a
Group 2: Cranes (100 ton rate capacity and over); Excavator over 2 cubic yards; Piledriver ($3.00 premium when operator controls hammer); Bauer Drill/Caisson. (Trade License Required)	42.11	25.30 + a
Group 3: Excavator; Backhoe/Excavator under 2 cubic yards; Cranes (under 100 ton rated capacity), Grader/Blade; Master Mechanic; Hoisting Engineer (all types of equipment where a drum and cable are used to hoist or drag material regardless of motive power of operation), Rubber Tire Excavator (Drott-1085 or similar);Grader Operator; Bulldozer Fine Grade. (slopes, shaping, laser or GPS, etc.). (Trade License Required)	41.32	25.30 + a
Group 4: Trenching Machines; Lighter Derrick; Concrete Finishing Machine; CMI Machine or Similar; Koehring Loader (Skooper).	40.91	25.30 + a
Group 5: Specialty Railroad Equipment; Asphalt Paver; Asphalt Reclaiming Machine; Line Grinder; Concrete Pumps; Drills with Self Contained Power Units; Boring Machine; Post Hole Digger; Auger; Pounder; Well Digger; Milling Machine (over 24	40.28	25.30 + a
Group 5 continued: Side Boom; Combination Hoe and Loader; Directional Driller; Pile Testing Machine.	40.28	25.30 + a
Group 6: Front End Loader (3 up to 7 cubic yards); Bulldozer (rough grade dozer).	39.95	25.30 + a
Group 7: Asphalt roller, concrete saws and cutters (ride on types), vermeer concrete cutter, Stump Grinder; Scraper; Snooper; Skidder; Milling Machine (24	39.59	25.30 + a
Group 8: Mechanic, grease truck operator, hydroblaster; barrier mover; power stone spreader; welding; work boat under 26 ft.; transfer machine.	39.17	25.30 + a
Group 9: Front end loader (under 3 cubic yards), skid steer loader regardless of attachments, (Bobcat or Similar): forklift, power chipper; landscape equipment (including Hydroseeder).	38.71	25.30 + a
Group 10: Vibratory hammer; ice machine; diesel and air, hammer, etc.	36.54	25.30 + a
Group 11: Conveyor, earth roller, power pavement breaker (whiphammer), robot demolition equipment.	36.54	25.30 + a

As of: September 9, 2020

Group 12: Wellpoint operator.	36.48	25.30 + a
Group 13: Compressor battery operator.	35.86	25.30 + a
Group 14: Elevator operator; tow motor operator (solid tire no rough terrain).	34.66	25.30 + a
Group 15: Generator Operator; Compressor Operator; Pump Operator; Welding Machine Operator; Heater Operator.	34.23	25.30 + a
Group 16: Maintenance Engineer/Oiler.	33.54	25.30 + a
Group 17: Portable asphalt plant operator; portable crusher plant operator; portable concrete plant operator.	38.11	25.30 + a
Group 18: Power safety boat; vacuum truck; zim mixer; sweeper; (Minimum for any job requiring a CDL license).	35.53	25.30 + a
------PAINTERS (Including Drywall Finishing)------		
10a) Brush and Roller	35.62	22.55
10b) Taping Only/Drywall Finishing	36.37	22.55
10c) Paperhanger and Red Label	36.12	22.55
10e) Blast and Spray	38.62	22.55
11) Plumber (excluding HVAC pipe installation) (Trade License required: P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2)	44.63	32.95
12) Well Digger, Pile Testing Machine	37.26	24.05 + a
13) Roofer (composition)	38.4	21.35
14) Roofer (slate & tile)	38.9	21.35
15) Sheetmetal Worker (Trade License required for HVAC and Ductwork: SM-1,SM-2,SM-3,SM-4,SM-5,SM-6)	38.9	39.46
16) Pipefitter (Including HVAC work) (Trade License required: S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4, G-1, G-2, G-8 & G-9)	44.63	32.95

As of: September 9, 2020

Project: Construction of Putnam CT DOT Repair & Maintenance Facility (Putnam)

------TRUCK DRIVERS------

17a) 2 Axle	29.86	25.79 + a
17b) 3 Axle, 2 Axle Ready Mix	29.97	25.79 + a
17c) 3 Axle Ready Mix	30.03	25.79 + a
17d) 4 Axle, Heavy Duty Trailer up to 40 tons	30.08	25.79 + a
17e) 4 Axle Ready Mix	30.13	25.79 + a
17f) Heavy Duty Trailer (40 Tons and Over)	30.35	25.79 + a
17g) Specialized Earth Moving Equipment (Other Than Conventional Type on-the-Road Trucks and Semi-Trailers, Including Euclids)	30.13	25.79 + a
18) Sprinkler Fitter (Trade License required: F-1,2,3,4)	45.92	26.08 + a
19) Theatrical Stage Journeyman	25.76	7.34

As of: September 9, 2020

Welders: Rate for craft to which welding is incidental.

**Note: Hazardous waste removal work receives additional $1.25 per hour for truck drivers.*

ALL Cranes: When crane operator is operating equipment that requires a fully licensed crane operator to operate he receives an extra $4.00 premium in addition to the hourly wage rate and benefit contributions:

1) Crane handling or erecting structural steel or stone; hoisting engineer (2 drums or over)

2) Cranes (100 ton rate capacity and over) Bauer Drill/Caisson

Crane with 150 ft. boom (including jib) - $1.50 extra
Crane with 200 ft. boom (including jib) - $2.50 extra
Crane with 250 ft. boom (including jib) - $5.00 extra
Crane with 300 ft. boom (including jib) - $7.00 extra
Crane with 400 ft. boom (including jib) - $10.00 extra

All classifications that indicate a percentage of the fringe benefits must be calculated at the percentage rate times the "base hourly rate".

Apprentices duly registered under the Commissioner of Labor's regulations on "Work Training Standards for Apprenticeship and Training Programs" Section 31-51-d-1 to 12, are allowed to be paid the appropriate percentage of the prevailing journeymen hourly base and the full fringe benefit rate, providing the work

The Prevailing wage rates applicable to this project are subject to annual adjustments each July 1st for the duration of the project.

Each contractor shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.

It is the contractor's responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's website.

The annual adjustments will be posted on the Department of Labor's Web page: www.ct.gov/dol. For those without internet access, please contact the division listed below.

The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project.

All subsequent annual adjustments will be posted on our Web Site for contractor access.

Contracting Agencies are under no obligation pursuant to State labor law to pay any increase due to the annual adjustment provision.

Effective October 1, 2005 - Public Act 05-50: any person performing the work of any mechanic, laborer, or worker shall be paid prevailing wage

All Person who perform work ON SITE must be paid prevailing wage for the appropriate mechanic, laborer, or worker classification.

All certified payrolls must list the hours worked and wages paid to All Persons who perform work ON SITE regardless of their ownership i.e.: (Owners, Corporate Officers, LLC Members, Independent Contractors, et. al)

Reporting and payment of wages is required regardless of any contractual relationship alleged to exist between the contractor and such person.

As of: September 9, 2020

Project: Construction of Putnam CT DOT Repair & Maintenance Facility (Putnam)

~~Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clause (29 CFR 5.5 (a) (1) (ii)).

Please direct any questions which you may have pertaining to classification of work and payment of prevailing wages to the Wage and Workplace Standards Division, telephone (860)263-6790.

As of: September 9, 2020

Minimum Rates and Classifications for
Heavy/Highway Construction

ID# 20-15558

Connecticut Department of Labor
Wage and Workplace Standards

By virtue of the authority vested in the Labor Commissioner under provisions of Section 31-53 of the General Statutes of Connecticut, as amended, the following are declared to be the prevailing rates and welfare payments and will apply only where the contract is advertised for bid within 20 days of the date on which the rates are established. Any contractor or subcontractor not obligated by agreement to pay

Project Number: #115-121 Project Town: Putnam
State#: #151-121 FAP#: Putnam
Project: Construction of Putnam CT DOL Repair & Maintenance Facility II (Putnam)

CLASSIFICATION	Hourly	Benefits
1) Boilermaker	33.79	34% + 8.96
1a) Bricklayer, Cement Masons, Cement Finishers, Plasterers, Stone Masons	35.72	33.16
2) Carpenters, Piledrivermen	34.53	25.64
2a) Diver Tenders	34.53	25.64
3) Divers	42.99	25.64
03a) Millwrights	34.94	26.19
4) Painters: (Bridge Construction) Brush, Roller, Blasting (Sand, Water, etc.), Spray	52.25	22.55
4a) Painters: Brush and Roller	35.62	22.55
4d) Painters: Blast and Spray	38.62	22.55
4e) Painters: Tanks, Tower and Swing	37.62	22.55
5) Electrician (Trade License required: E-1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9)	40.25	29.17+3% of gross wage
6) Ironworkers: Ornamental, Reinforcing, Structural, and Precast Concrete Erection	36.67	37.62 + a

As of: September 14, 2020

7) Plumbers (Trade License required: (P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2) and Pipefitters (Including HVAC Work) (Trade License required: S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4 G-1, G-2, G-8, G-9)	44.63	32.95
----LABORERS---- -		
8) Group 1: Laborer (Unskilled), Common or General, acetylene burner, concrete specialist	31.0	22.15
9) Group 2: Chain saw operators, fence and guard rail erectors, pneumatic tool operators, powdermen	31.25	22.15
10) Group 3: Pipelayers	31.5	22.15
11) Group 4: Jackhammer/Pavement breaker (handheld); mason tenders (cement/concrete), catch basin builders, asphalt rakers, air track operators, block paver, curb setter and forklift operators	31.5	22.15
12) Group 5: Toxic waste removal (non-mechanical systems)	33.0	22.15
13) Group 6: Blasters	32.75	22.15
Group 7: Asbestos/lead removal, non-mechanical systems (does not include leaded joint pipe)	32.0	22.15
Group 8: Traffic control signalmen	18.0	22.15
Group 9: Hydraulic Drills	29.3	18.90
----LABORERS (TUNNEL CONSTRUCTION, FREE AIR). Shield Drive and Liner Plate Tunnels in Free Air.----		
13a) Miners, Motormen, Mucking Machine Operators, Nozzle Men, Grout Men, Shaft & Tunnel Steel & Rodmen, Shield & Erector, Arm Operator, Cable Tenders	33.23	22.15 + a
13b) Brakemen, Trackmen	32.26	22.15 + a
----CLEANING, CONCRETE AND CAULKING TUNNEL----		
14) Concrete Workers, Form Movers, and Strippers	32.26	22.15 + a
15) Form Erectors	32.59	22.15 + a

As of: September 14, 2020

Project: Construction of Putnam CT DOL Repair & Maintenance Facility II (Putnam)

----ROCK SHAFT LINING, CONCRETE, LINING OF SAME AND TUNNEL IN FREE AIR:----		
16) Brakemen, Trackmen, Tunnel Laborers, Shaft Laborers	32.26	22.15 + a
17) Laborers Topside, Cage Tenders, Bellman	32.15	22.15 + a
18) Miners	33.23	22.15 + a
----TUNNELS, CAISSON AND CYLINDER WORK IN COMPRESSED AIR: ----		
18a) Blaster	39.72	22.15 + a
19) Brakemen, Trackmen, Groutman, Laborers, Outside Lock Tender, Gauge Tenders	39.52	22.15 + a
20) Change House Attendants, Powder Watchmen, Top on Iron Bolts	37.54	22.15 + a
21) Mucking Machine Operator	40.31	22.15 + a
----TRUCK DRIVERS----(*see note below)		
Two axle trucks	29.86	25.79 + a
Three axle trucks; two axle ready mix	29.97	25.79 + a
Three axle ready mix	30.03	25.79 + a
Four axle trucks, heavy duty trailer (up to 40 tons)	30.08	25.79 + a
Four axle ready-mix	30.13	25.79 + a
Heavy duty trailer (40 tons and over)	30.35	25.79 + a
Specialized earth moving equipment other than conventional type on-the road trucks and semi-trailer (including Euclids)	30.13	25.79 + a
----POWER EQUIPMENT OPERATORS----		

Project: Construction of Putnam CT DOL Repair & Maintenance Facility II (Putnam)

Group 1: Crane handling or erecting structural steel or stone, hoisting engineer (2 drums or over), front end loader (7 cubic yards or over), Work Boat 26 ft. & Over, Tunnel Boring Machines. (Trade License Required)	42.45	25.30 + a
Group 2: Cranes (100 ton rate capacity and over); Excavator over 2 cubic yards; Piledriver ($3.00 premium when operator controls hammer); Bauer Drill/Caisson. (Trade License Required)	42.11	25.30 + a
Group 3: Excavator/Backhoe under 2 cubic yards; Cranes (under 100 ton rated capacity), Gradall; Master Mechanic; Hoisting Engineer (all types of equipment where a drum and cable are used to hoist or drag material regardless of motive power of operation), Rubber Tire Excavator (Drott-1085 or similar);Grader Operator; Bulldozer Fine Grade (slopes, shaping, laser or GPS, etc.). (Trade License Required)	41.32	25.30 + a
Group 4: Trenching Machines; Lighter Derrick; Concrete Finishing Machine; CMI Machine or Similar; Koehring Loader (Skooper)	40.91	25.30 + a
Group 5: Specialty Railroad Equipment; Asphalt Paver; Asphalt Spreader; Asphalt Reclaiming Machine; Line Grinder; Concrete Pumps; Drills with Self Contained Power Units; Boring Machine; Post Hole Digger; Auger; Pounder; Well Digger; Milling Machine (over 24	40.28	25.30 + a
Group 5 continued: Side Boom; Combination Hoe and Loader; Directional Driller.	40.28	25.30 + a
Group 6: Front End Loader (3 up to 7 cubic yards); Bulldozer (rough grade dozer).	39.95	25.30 + a
Group 7: Asphalt Roller; Concrete Saws and Cutters (ride on types); Vermeer Concrete Cutter; Stump Grinder; Scraper; Snooper; Skidder; Milling Machine (24	39.59	25.30 + a
Group 8: Mechanic, Grease Truck Operator, Hydroblaster, Barrier Mover, Power Stone Spreader; Welder; Work Boat under 26 ft.; Transfer Machine.	39.17	25.30 + a
Group 9: Front End Loader (under 3 cubic yards), Skid Steer Loader regardless of attachments (Bobcat or Similar); Fork Lift, Power Chipper; Landscape Equipment (including hydroseeder).	38.71	25.30 + a
Group 10: Vibratory Hammer, Ice Machine, Diesel and Air Hammer, etc.	36.54	25.30 + a
Group 11: Conveyor, Earth Roller; Power Pavement Breaker (whiphammer), Robot Demolition Equipment.	36.54	25.30 + a
Group 12: Wellpoint Operator.	36.48	25.30 + a
Group 13: Compressor Battery Operator.	35.86	25.30 + a

As of: September 14, 2020

Group 14: Elevator Operator; Tow Motor Operator (Solid Tire No Rough Terrain).	34.66	25.30 + a
Group 15: Generator Operator; Compressor Operator; Pump Operator; Welding Machine Operator; Heater Operator.	34.23	25.30 + a
Group 16: Maintenance Engineer/Oiler	33.54	25.30 + a
Group 17: Portable asphalt plant operator; portable crusher plant operator; portable concrete plant operator.	38.11	25.30 + a
Group 18: Power Safety Boat; Vacuum Truck; Zim Mixer; Sweeper; (minimum for any job requiring CDL license).	35.53	25.30 + a
**NOTE: SEE BELOW		
----LINE CONSTRUCTION----(Railroad Construction and Maintenance)----		
20) Lineman, Cable Splicer, Technician	48.19	6.5% + 22.00
21) Heavy Equipment Operator	42.26	6.5% + 19.88
22) Equipment Operator, Tractor Trailer Driver, Material Men	40.96	6.5% + 19.21
23) Driver Groundmen	26.5	6.5% + 9.00
23a) Truck Driver	40.96	6.5% + 17.76
----LINE CONSTRUCTION----		
24) Driver Groundmen	30.92	6.5% + 9.70
25) Groundmen	22.67	6.5% + 6.20
26) Heavy Equipment Operators	37.1	6.5% + 10.70
27) Linemen, Cable Splicers, Dynamite Men	41.22	6.5% + 12.20
28) Material Men, Tractor Trailer Drivers, Equipment Operators	35.04	6.5% + 10.45

As of: September 14, 2020

Welders: Rate for craft to which welding is incidental.

**Note: Hazardous waste removal work receives additional $1.25 per hour for truck drivers.*

ALL Cranes: When crane operator is operating equipment that requires a fully licensed crane operator to operate he receives an extra $4.00 premium in addition to the hourly wage rate and benefit contributions:

1) Crane handling or erecting structural steel or stone; hoisting engineer (2 drums or over)

2) Cranes (100 ton rate capacity and over) Bauer Drill/Caisson

Crane with 150 ft. boom (including jib) - $1.50 extra
Crane with 200 ft. boom (including jib) - $2.50 extra
Crane with 250 ft. boom (including jib) - $5.00 extra
Crane with 300 ft. boom (including jib) - $7.00 extra
Crane with 400 ft. boom (including jib) - $10.00 extra

All classifications that indicate a percentage of the fringe benefits must be calculated at the percentage rate times the "base hourly rate".

Apprentices duly registered under the Commissioner of Labor's regulations on "Work Training Standards for Apprenticeship and Training Programs" Section 31-51-d-1 to 12, are allowed to be paid the appropriate percentage of the prevailing journeymen hourly base and the full fringe benefit rate, providing the work

Project: Construction of Putnam CT DOL Repair & Maintenance Facility II (Putnam)

~~Connecticut General Statute Section 31-55a: Annual Adjustments to wage rates by contractors doing

The Prevailing wage rates applicable to this project are subject to annual adjustments each July 1st for the duration of the project.

Each contractor shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.

It is the contractor's responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's website.

The annual adjustments will be posted on the Department of Labor's Web page: www.ct.gov/dol. For those without internet access, please contact the division listed below.

The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project.

All subsequent annual adjustments will be posted on our Web Site for contractor access.

Contracting Agencies are under no obligation pursuant to State labor law to pay any increase due to the annual adjustment provision.

Effective October 1, 2005 - Public Act 05-50: any person performing the work of any mechanic, laborer, or worker shall be paid prevailing wage

All Person who perform work ON SITE must be paid prevailing wage for the appropriate mechanic, laborer, or worker classification.

All certified payrolls must list the hours worked and wages paid to All Persons who perform work ON SITE regardless of their ownership i.e.: (Owners, Corporate Officers, LLC Members, Independent Contractors, et. al)

Reporting and payment of wages is required regardless of any contractual relationship alleged to exist between the contractor and such person.

~~Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clause (29 CFR 5.5 (a) (1) (ii)).

Please direct any questions which you may have pertaining to classification of work and payment of prevailing wages to the Wage and Workplace Standards Division, telephone (860)263-6790.

As of: September 14, 2020