

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.

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MARCH 25, 2020
FEDERAL AID PROJECT NO.: N/A
STATE PROJECT NO. 320-019

NEW HAVEN – HARTFORD – SPRINGFIELD RAIL PROGRAM
SHORT HIGH-LEVEL PLATFORM STATION

Town of Windsor

The State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, Facilities and Incidental Construction, Form 817, 2016, as revised by the Supplemental Specifications dated July 2019 (otherwise referred to collectively as "ConnDOT Form 817") is hereby made part of this contract, as modified by the Special Provisions contained herein. Form 817 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 SHORT HIGH-LEVEL PLATFORM STATION in the Town of Windsor.

CONTRACT TIME AND LIQUIDATED DAMAGES

One Hundred Eighty-Three (183) calendar days will be allowed for completion of the work on this Contract and the liquidated damages charge to apply will be One Thousand Five Hundred Dollars (\$1,500.00) per calendar day.

MARCH 25, 2020
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STATE PROJECT NO. 320-019

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CONTRACT TIME AND LIQUIDATED DAMAGES

A total of _____ () calendar days will be allowed for completion of all work on this Contract.

One Hundred Eighty-Three (183) calendar days will be allowed for completion of all work, excluding the planting and the liquidated damages charge to apply will be One Thousand Five Hundred Dollars (\$1,500.00) per calendar day.

In addition, starting on _____, _____ () calendar days will be allowed for the completion of the planting and the liquidated damages charge to apply will be _____ Dollars (\$) per calendar day that the planting work remains incomplete.

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 - PROJECT DESCRIPTION

The Project consists of temporary 52-foot long high-level boarding platforms and associated improvements and upgrades to the existing railroad station located at 41 Central Street in Windsor, Connecticut as shown and described in the Contract.

The project will construct new 52-foot long high-level boarding platforms with stair and ramp access. The platforms will include guardrails, premanufactured shelters, bench seating, blue light phones, passenger information display signs and variable instant messaging signs.

The platform assemblies will consist of pile-supported, Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels on steel beams supporting the platform. An integral electric snow-melt system will be incorporated into the Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels and run back to a new centralized utility building housing the power, lighting, controls and telecommunications equipment. Platform, ramp and stair steel guardrails will be shop-fabricated, and shop painted with a high-performance coating system.

The west side (Track 1) proposed construction is integrated into recent station improvements including a new ADA ramp and HC parking area. The project includes construction of a new cast-in-place concrete ramp leading to the platform and a new sloping concrete and fiberglass grating sidewalk connecting the existing HC parking area to the landing of the ADA ramp. In addition, the construction includes a new wheelchair lift pad and modifications to the existing one to serve as a storm drainage structure and support for the fiberglass grating spanning over top.

The east side (Track 2) proposed construction is supported on the recently built low-level platform. The construction includes another high-level Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panel platform, as well as Reinforced Modular Polymer Composite ramp and stair connecting the platform to the existing low-level boarding platform. The steel beams supporting the light weight Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panel platform transfer the load to the foundation walls of the low-level platform.

Lighting, fire alarms and CCTV security cameras are included on both platforms and in the utility building.

A complete package of wayfinding, regulatory, and informational signs are also included as part of the overall station package. Variable message signs and PA systems are also included.

Site work associated with the upgraded facility consists of excavation and minor grading work to accommodate the station components (sidewalk, ramp, utility building, site lighting and signage).

NOTICE TO CONTRACTOR - SUBMITTALS

The Contractor is hereby notified that submittals, including shop and working drawings, computations and calculations, catalog cuts, data sheets and all other materials the Contractor submits to ConnDOT shall be PREPARED AND SUBMITTED IN DIGITAL FORMAT. All correspondence including drawings submitted for review and/or approval, submittals, etc. will be transmitted by all parties in digital format, in accordance with Form 817 Article 1.20-1.05.02 and the latest ConnDOT Policies and Procedures. All submittals shall be produced and controlled using SharePoint, in accordance with Item No. 0969050A – Document Control Specialist.

Transmittal of Submittals: Unless otherwise stipulated, all submittals requiring review for conformance with the Contract shall be digitally transmitted to Michael Baker International, Inc., ATTN: Tyler Tompkins, 500 Enterprise Drive, Suite 2B, Rocky Hill, Connecticut 06067

Transmittal letters shall be sent digitally via the SharePoint System (Email Notification) to Mr. Bruce A. Olmstead, P.E., Transportation Supervising 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, ATTN: Mrs. Angela Maynard; and to the District 1A Administration Office, 700 State Street, Suite 101, New Haven, CT 06511, ATTN: Mohammed Bishtawi. The appropriate distributions will be set up by the Program Manager (PB) prior to the Notice to Proceed.

Submittals requiring review for conformance with the Contract that shall be submitted digitally to the Assistant District Engineer in lieu of the Designer are listed below:

Project Management
Project Coordinator
Major Lump Sum Item Schedule of Values
Quality Control Plan
Photographer
Construction Field Office and Materials
Computer Peripherals
Emergency Numbers
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 817 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

Submittals requiring review for conformance with the Environmental Contract will also be sent digitally via the SharePoint System to Denise Young, DOT Environmental Compliance, Bureau of Engineering and Construction, Connecticut Department of Transportation, 2800 Berlin Turnpike, P.O. Box 317546, Newington, CT 06131-7546. The appropriate distributions will be set up by the Program Manager (PB) prior to the Notice to Proceed.

Health and Safety Plan
Disposal Plan and Site

Submittal Preparation and Processing: The Contractor shall provide the Designer with complete submittal packages (Product Data, Shop Drawings, Samples, and Quality Assurance Submittals, as applicable) for individual elements of Project work for a concurrent review of all information. Incomplete submittal packages will be returned to the Contractor without being reviewed.

The Contractor shall also provide FM Global with one (1) printed copy of the any submittals required as part of the Notice to Contractor – FM Global Submittals and/or as required in the specifications. Address:

FM Global, Boston Operations
1175 Boston-Providence Turnpike
Norwood, MA 02062

All submittals are to be packaged in PDF format according to guides provided by the Program Management Team (PB) and transmitted digitally using the SharePoint System. For all approved submittals, the Contractor shall maintain a record copy (paper print) of approved submittals on site at the field trailer and transmit 1 paper copy of approved submittals to the designated CTDOT inspection field office addressed to District 1 Engineer – Donald Ward.

Samples: Where Samples are for selection of color, pattern, texture or similar characteristics from a range of choices, submit two (2) full sets of the standard and custom choices for the material or product. Where Samples illustrate assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit one (1) sample (or set, if applicable).

Designer's Action: The Designer will digitally return submittals marked with action taken and corrections or modifications required.

Shop Drawings: The Designer will return shop drawings digitally. The digital copy shall be considered a "Record Document" and maintained as such.

Samples: The Designer will return one set of samples marked with the action taken. The set of samples shall be maintained at the Project site when returned.

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

Other key construction 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 817 Article 1.20-1.05.02. The following items have been identified:

Architecturally-Exposed Structural Steel Framing
Structural Steel Framing
Variable Messaging Sign Head-End Equipment
Passenger Information Display System (PIDS)
Structural Fiber Reinforced Modular Polymer Composite Deck and Surface-Applied Panels
Snow Melt Heating Panels

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

Selection of the Project Coordinator
Baseline Critical Path Schedule
Contractor's Submittal Schedule
Health and Safety Plan
Platform Layout Plan (approval by AMTRAK)

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.

NOTICE TO CONTRACTOR - FRA ALCOHOL AND DRUG TESTING

On October 16, 2008, the United States Congress enacted the Rail Safety Improvement Act of 2008 (RSIA). RSIA directs the Federal Railroad Administration (FRA) to promulgate new safety regulations related to railroad safety. The purpose of this NTC is to notify you of certain requirements recently promulgated by the FRA that may be applicable to work you are Currently performing, or may in the future perform, for the Connecticut Department of Transportation (Department).

On June 10, 2016, the FRA published a final rule expanding the scope of its drug and alcohol testing regulations (FRA Regulations) to provide that “each railroad must ensure that a regulated employee is subject to being selected for random testing... whenever the employee performs regulated service on the railroad’s behalf.” 49 C.F.R. § 219.601. A “regulated employee” includes a contractor to a railroad or any individual who is performing activities for a railroad and includes those contractors, consultants or individuals who are deemed “maintenance-of-way” employees under 49 C.F.R. Part 219 (See 49 C.F.R. §219.5).

The term maintenance-of-way (MOW) employee, as used in 49 C.F.R. Part 219, is defined in 49 C.F.R. § 214.7 as “any employee...of a contractor to a railroad, whose duties include inspection, construction, maintenance or repair of railroad track, bridges, roadway, signal and communications systems, electric traction systems, roadway facilities or roadway maintenance machinery on or near track or with the potential of fouling a track, and flagmen and watchmen/lookouts.” (collectively, MOW Activities).

The final rule, which is effective June 12, 2017, requires contractors and consultants employing MOW employees to submit a Part 219 Compliance Plan to FRA prior to the effective date. Please consult the following link to the model drug and alcohol plan prepared by the FRA for guidance.

<https://www.fra.dot.gov/eLib/details/L02814>

The final rule mandates, among other things, the establishment of a random testing pool to ensure a testing rate of 50% of MOW employees for drugs and 25% of MOW employees for alcohol on an annual basis. For more information related to the requirements, please refer to:

<http://www.ecfr.gov/cgi-bin/text-idx?rgn=div5&node=49:4.1.1.1.14>

Every contractor or consultant that is performing MOW Activities must comply with its obligations under 49 C.F.R. Part 219 to ensure that all MOW employees are being randomly tested for drugs and alcohol. Failure of a contractor or consultant to timely comply with the FRA Regulations may subject that firm to civil penalties. In addition, AMTRAK has stated that contractors or consultants who do not comply with the FRA regulations will not be able to work on AMTRAK property.

The Department strongly urges all contractors and consultants to consult with their attorneys and/or to conduct their own independent due diligence regarding the requirements imposed by the new FRA Regulations to determine what steps are necessary to assure compliance. The information provided herein is advisory in nature and is offered without warranty of any kind. The Department does not accept any responsibility or liability for the accuracy, content, completeness, legality, or reliability of the information contained herein.

Any questions regarding the FRA Regulations concerning drug and alcohol testing should be directed to: Mr. Gerald Powers, Drug and Alcohol Program Manager, Office of Safety Enforcement, Federal Railroad Administration, 1200 New Jersey Avenue SE, Mail Stop 25, Washington, DC 20590 or via telephone (202) 4936313.

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. Special Provision: Form 817 Section 0947003A, "Bus Passenger Shelter".
2. Metals: CSI Division Section 051300, "Retractable Platform Edge".
3. Cast Polymer Fabrications: CSI Division Section 066100, "Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels".
4. Specialties: CSI Division Section 104060, "Trash/Recycling Receptacles".
5. Lighting: CSI Division Section 265600, "Lighting".
6. Data Communications Network Equipment: CSI Division Section 272133, "Data Communications Wireless Access Points".
7. Snow Melting Systems: CSI Division Section 321743, "Snow Melt Heating Panels".
8. Fences and Gates: CSI Division Section 323119, "Decorative Metal Fences and Gates".

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 Repellants."
3. Division 07 Section 072100, "Thermal Insulation."
4. Sheet Underlayment: Division 07 Section 073200, "Composite Roof Tile Systems".
5. All products but Metals, Fasteners: Division 07 Section 074113, "Formed Metal Roof Panels."
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. Division 07 Section 079200, "Joint Sealants."
9. Division 09 Section 092900, "Gypsum Board."
10. Tapes and Adhesives: Division 10 Section 104250, "Signage."
11. Division 23 Section 230713, "Duct Insulation."
12. Division 23 Section 230719, "HVAC Piping Insulation."
13. Division 23 Section 232001, "HVAC Piping and Joints."
14. Flexible Connectors: Division 23 Section 233100, "Sheet Metal Work and Accessories."
15. Sealants: Division 23 Section 233100, "Sheet Metal Work and Accessories."
16. Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables."
17. Division 260533, "Raceways and Boxes for Electrical Systems".

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. Pre-demolition: Form 817 Article 1.20-1.08.03 – Prosecution of Work, subsection 5 – Selective Demolition.
2. Micropiles: Verification Test for Micropiles, Proof Test for Micropiles, and Micropile Length Adjustment, Form 817 Article 7.06.
3. Cast-In-Place Concrete: CSI Division 3 Section 033000, “Cast-In-Place Concrete.”
4. Clay Masonry Unit: CSI Division 4 Section 042113, “Brick Masonry.”
5. Structural Steel Framing: CSI Division 5 Section 051200, “Structural Steel Framing.”
6. Structural Steel Framing: CSI Division 5 Section 051213, “Architecturally Exposed Structural Steel Framing.”
7. Cast Polymer Fabrications: CSI Division 6 Section 066100, “Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels.”
8. Thermal and Moisture Protection: CSI Division 7 Section 073200, “Composite Roof Tile Systems.”
9. Thermal and Moisture Protection: CSI Division 7 Section 074113, “Formed Metal Roof Panels”
10. Painting: CSI Division 9 painting Sections
11. Tactile Warning Surface: CSI Division 9 Section 093050, “Tactile Warning Strip – Surface Applied.”
12. Specialties: CSI Division 10 Section 104250, “Site Wayfinding & Identification Signage.”
13. Testing, Adjusting, and Balancing: CSI Division 23 Section 230593, “Testing, Adjusting, and Balancing for HVAC.”
14. Convection Heating and Cooling Units: CSI Division 23 Section 238240, “DX Mini-Splits System.”
15. Common Work Results for Electrical: Raceway and Boxes for Electrical Systems, CSI Section 260533
16. Video Surveillance: CSI Division 28 Section 282301, “Video Surveillance System.”
17. Intrusion Detection: CSI Division 28 Section 283101 “Fire Alarm System.”
18. Pavement Snow Melting Systems: CSI Division 32 Section 321743 “Snow Melt Heating Panels.”

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 817 Article 1.20-1.08.14. The Designer and the Owner (**Mr. Richard Jankovich, Office of Rails**) 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 817 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.

TABLE

Special Provision (including CSI-formatted Specifications)	Warranties	Spare Parts	Training	Operation and Maintenance Manuals
CSI Section 051300, "Retractable Platform Edge"	X	X		X
CSI Section 066100, "Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels"	X			
CSI Section 066400, "Polyethethylene Platform Edge Strips"		X		
CSI Section 071900, "Water Repellents"	X			
CSI Section 073200, "Composite Roof Tile Systems"	X	X		
CSI Section 074113.16, "Formed Metal Roof Panels"	X			
CSI Section 074230, "Soffit Panels"	X			X

Special Provision (including CSI-formatted Specifications)	Warranties	Spare Parts	Training	Operation and Maintenance Manuals
CSI Section 074650, "Exterior Siding and Trim"	X			X
CSI Section 076200, "Sheet Metal Flashing and Trim"	X			X
CSI Section 077100, "Roof Specialties"	X			X
CSI Section 079200, "Joint Sealants"	X			
CSI Section 087100, "Door Hardware"	X			X
CSI Section 099113, "Exterior Painting"		X		
CSI Section 099610, "Graffiti Control"	X			
CSI Section 099613, "Interior Epoxy Painting"	X	X		
CSI Section 104060, "Trash Receptacles"	X	X		
CSI Section 104070, "Bicycle Parking Racks"	X			
CSI Section, "Emergency Key Cabinet"	X			
CSI Section 104250, "Site Wayfinding & Identification Signage"	X			
CSI Section 230500, "Basic Mechanical Materials and Methods"	X			X
CSI Section 230593, "Testing, Adjusting, and Balancing"				X
CSI Section 233900, "Fans and Accessories"	X		X	X
CSI Section 238235, "Terminal Heat Transfer Units"	X			
CSI Section 238240, "DX Mini-Splits"	X		X	X
CSI Section 238323, "Electric Snow Melt System"	X		X	X
CSI Section 260500, "Common Work Results for Electrical"	X			X
CSI Section 260923, "Lighting Control Devices"	X		X	X
CSI Section 262200, "Low-Voltage Transformers"	X			X
CSI Section 262416, "Panelboards"	X	X		X
CSI Section 262726, "Wiring Devices"				X
CSI Section 262816, "Enclosed Switches and Circuit Breakers"	X			
CSI Section 263353, "Static Uninterruptible Power Supply"	X		X	X
CSI Section 264313, "Surge Protection Devices for Low Voltage"	X			X
CSI Section 265200, "Emergency Lighting"	X			
CSI Section 265600, "Lighting"		X		X
CSI Section 273226, "Blue Light/Emergency Telephone System"	X			X
CSI Section 274216, "Passenger Information Display"				X

Special Provision (including CSI-formatted Specifications)	Warranties	Spare Parts	Training	Operation and Maintenance Manuals
(PID) Systems”				
CSI Section 275116, “Public Address System”				X
CSI Section 282301, “Video Surveillance System”	X		X	X
CSI Section 283101, “Fire Alarm System”	X		X	X
CSI Section 321743, “Snow Melt Heating Panels”	X		X	X
CSI Section 323119, “Decorative Metal Fences and Gates”	X			
Form 817 Item 0947003A, “Bus Passenger Shelter”	X	X		

NOTICE TO CONTRACTOR - UTILITY SERVICE CONNECTIONS [AND RELOCATIONS]

The **electric, telephone, gas, and water (including fire protection)**, services to the Project Site require service connections **to** the applicable utility company's facilities. Utility service connection **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:

Storm: **Town of Windsor**

Mr. Philip J. Sissick
Director of Public Works
Stanton Road
Windsor Locks, CT 06096
Phone: 860-627-1405
psissick@wlocks.com

Water: **MDC – The Metropolitan District**

Mr. Richard Norris, P.E.
Project Engineer/ Utility Liaison
555 Main Street, P.O. Box 800
Hartford, CT 06142-0800
Phone: 860-278-7850 EXT: 3450
rnorris@themdc.com

Gas: **Connecticut Natural Gas (CNG)**

Mr. Jonathan Gould
Gas Engineer
76 Meadow Street, 2nd Floor
East Hartford, CT 06108
Phone: 860-727-3044
jgould@ctgcorp.com

Electric: Eversource

The Connecticut Light & Power Company dba Eversource Energy – Electric Distribution

Mr. Thomas Woronik

Supervisor – Construction Engineering

22 East High Street

East Hampton, CT 06424

Phone: 860-267-3891

Thomas.Woronik@eversource.com

Map Requests: numaprequest@eversource.com

Telephone: Frontier Connecticut

The Southern New England Telephone Company dba Frontier Communications of Connecticut

Ms. Lynne DeLucia

Manager – Engineering & Construction

1441 North Colony Road

Meriden, CT 06450-4101

Phone: 203-238-5000

Mobile:860-967-4389

Lynne.m.delucia@ft.com

Map Requests: FTR-CT-MAPREQUEST@ftr.com

See the Utility Mailing List:

<https://portal.ct.gov/-/media/DOT/documents/dutilities/Utility-Mailing-List.pdf?la=en>

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.

NOTICE TO CONTRACTOR - CAD FILES

The Contractor is hereby advised that CAD files will not be provided to construction contract bidders, the Contractor, or any subcontractor. Contract documents, including plans, are provided in Portable Document Format (PDF).

The Department AEC Applications unit has prepared technical reference materials on extending the utility of PDF contract plan sheets. See the Repurposing PDF Contract Plan Sheets web page <http://www.ct.gov/dot/cwp/view.asp?a=2288&Q=567262&PM=1>.

The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR - STATION OPERATION

The Contractor is advised that there will be no interruption of station services during construction. The Contractor shall provide a safe, accessible, well-marked route for commuters to reach all temporary facilities and all platforms at all times and shall maintain all temporary facilities so that they remain free of hazards. The Contractor shall schedule work that will require closure of a platform during night hours after station operations have ceased for the day. The Contractor shall put in place temporary barricades and safety devices as required to return the entire platform to operation the following morning. For further guidance refer to Form 817 Section 1.08 – Prosecution and Progress, and Section 1.20-1.08 – Persecution and Progress for Facilities Construction.

NOTICE TO CONTRACTOR - WORK ON RAILROAD PROPERTY

The Contractor acknowledges that work to be accomplished under this Contract is to be performed on Railroad territory, which consists of territory operated by National Railroad Passenger Corporation (AMTRAK). The Contractor's work must be accomplished simultaneously with ongoing daily Railroad operations. Such operations include, but are not limited to, the passage of trains, storage of trains, flagging, inspection, repair, construction, reconstruction, and maintenance of the railroad right-of-way and facilities.

The Contractor is advised that the Railroad controls all activity in the respective right-of-way, and the Department expects that these conditions may cause delays and possibly a complete suspension of construction activity. The Contractor shall consider normal Railroad operations and associated impacts to the construction schedule. The Contractor shall not be entitled to time extensions for delays associated with normal Railroad operations. If the Contractor is delayed or suspended in the completion of the work by atypical railroad operations including, but not limited to, activities associated with a derailment, major track failure, or extended power outage, the Contractor will be entitled to a time extension for every day that he can demonstrate that the delays affected the completion date of the Contract. This extension of time will be considered non-compensable and the Contractor will not be entitled to any additional compensation for damages incurred for all direct and indirect costs including, but not limited to, all delay and impact costs, and inefficiencies.

The Contractor shall be responsible for obtaining the "Temporary Permit to Enter Upon Property" included elsewhere in this Contract. The cost of obtaining this permit including the cost of complying with the Specifications attached to the permit (Insurance, Safety, Training, etc.) shall be included in the MLSI. The cost of Railroad Flag Protection necessary to complete the work shown in the Contract, as well as the cost of other work shown in the Contract to be performed by AMTRAK Forces, shall be paid directly by the State under separate Force Account Agreement.

The Contractor shall be responsible for the coordination of the work of its various subcontractors. The Contractor shall coordinate its operations with those of the Railroad Company in carrying out railroad force account.

The Contractor must make its own arrangements with the Railroad Company for the use of Railroad equipment or changes in Railroad facilities made solely to facilitate the Contractor's operations. The expense incurred by making such arrangements shall not be a part of this Contract.

Contractor Requirements for Work Affecting the Railroad

The Contractor shall be governed by AMTRAK EP3014 and the General Requirements and Covenants of the Contract.

1. All matters requiring Railroad Company approval or coordination shall be directed to:

Madeleine Respler
AMTRAK
Engineering – I&C
30th Street Station, Box 64
2955 Market Street
Philadelphia, PA 19104
Phone: 215-349-4367
madeleine.respler@amtrak.com

and

Keith Hogan
AMTRAK
Senior Engineer, Capital Construction
76 Depot Road
Berlin, CT 06037
Office 860-829-2260
Mobile 860-237-7395
Keith.hogan@amtrak.com

2. In general, unless otherwise authorized by the Railroad, operations directly over or adjacent to the operating right-of-way shall be performed during the following time periods:

Block of Available Foul Time (Single or Double Track)

Sunday Night – Monday Morning
11:00PM – 5:00AM (freight movements expected within this window)

Monday Night – Friday Morning
11:59PM – 5:00AM (freight movements expected within this window)

Friday Night – Saturday Morning
11:59PM – 6:00AM

Saturday Night - Sunday Morning
11:00PM – 6:00AM

Temporary at-grade crossings across any tracks WILL NOT be permitted. The Contractor shall provide a minimum of 30 calendar days advance notice for the scheduling of any work to be performed by AMTRAK forces.

All work involving rail, ties, overhead electrification, and other track components on active tracks, unless specifically designated otherwise within the Contract, will be performed by AMTRAK employees. The Contractor may not remove abandoned track (out of service) unless given prior written approval from the Engineer and AMTRAK.

Notes:

1. The hours shown for available foul time are the times the track(s) may be taken be out of service for Contractor activities. However, it should be noted the identified blocks of available foul time above are subject to suspension or revocation due to, but not limited to, scheduled freight movements, late or delayed passenger trains, track maintenance activities, locomotive/coach dead head movements, track car movements, train equipment movements and emergency or unplanned activities. The Contractor shall understand that while freight movements are anticipated within blocks of available foul time identified above, these hours and days of availability are subject to change in the future. In addition, passenger train schedules are also subject to change, which may alter or shorten blocks of available foul time. Outside the blocks of available foul time identified above, the Contractor is not precluded from requesting foul time, however, the Contractor shall expect very limited durations based on current passenger train and freight movements.
2. Track outages will be considered as requests are submitted but not necessarily granted. While every effort will be made to accommodate the Project's needs, track outages cannot be guaranteed. Track outages are dependent on many circumstances; including weather, availability of protective personnel, conflicts with other projects and unforeseen operating problems. Therefore, no claims may be made against AMTRAK for delays due to unavailability of track. Further, requests for track outages must identify Contractor activities that are deemed necessary for construction, not merely for the Contractor's convenience. In the event a track outage is granted, the Contractor shall understand time needs to be allotted to AMTRAK to take the track out of service and return the track back into service within the duration of the outage.
3. Station area work shall be performed, and flag protection acquired, in accordance with AMTRAK safety procedures. The Contractor shall be made aware of weeks in which holidays occur or weeks abutting holidays may result in limited availability of railroad protective personnel. The Contractor shall plan and execute their work accordingly.
4. Use of existing parking areas or Railroad property for construction activities, materials storage, or other work that would limit use of all existing parking or Railroad operation is strictly prohibited. Contractor shall review the Staging Plan for proposed work areas.

Date 6/27/19

NOTICE TO CONTRACTOR - PHOTO IDENTIFICATION

The Contractor is hereby notified that all employees, including subcontractors, who will work on the Project will be required to carry personal photo identification, such as a valid driver's license.

NOTICE TO CONTRACTOR - RAILROAD SAFETY TRAINING

All individuals employed by the Contractor and its subcontractors shall attend AMTRAK's Safety Contractor/Leasee Employee Training Class prior to entering onto the Railroad's property or coming within twenty-five (25) feet of the centerline of the track or energized wires. It is the Contractor's responsibility to arrange this Safety Training. All costs associated with this class shall be included in the Major Lump Sum Item for the project.

NOTICE TO CONTRACTOR - MAINTAINING ROADWAY ACCESS TO TRACKS

The Contractor is hereby advised that maintaining access to all railroad tracks and equipment through the site for railroad and State employees, as well as for emergency vehicles, is hereby required. The Contractor shall construct a temporary access road to insure that access to the tracks and equipment is continuous during construction activities. Removal of the temporary access road shall be coordinated with the Engineer during construction.

NOTICE TO CONTRACTOR - LIGHT POLLUTION CONTROL

Due to AMTRAK operating restrictions, much of the work on this project will occur during nighttime hours and will require the use of construction lighting for its safe prosecution. The Contractor shall position and shield its construction lighting, at each site, such that the light does not fall directly on residences adjacent to the Project Site. All costs associated with light pollution control shall be included in the MLSI for the Project.

NOTICE TO CONTRACTOR - TRACK MONITORING

Application

Track monitoring is required for construction work that could affect the stability of the track, or any earth disturbing construction activity that is within 50 feet of the centerline of the nearest track or construction work that is within the influence line of the track. Construction activities that typically trigger the need for track monitoring include excavation, dewatering, pile driving or pipe jacking.

Examples of the types of projects in which track monitoring is required:

1. Underground pipe crossing by jacking or horizontal directional drilling.
2. Local excavation, such as for catenary structure foundation.
3. Excavation that is parallel to the track, such as construction of ditch or utility trench.

Purpose

The purpose of track monitoring is to record railroad track data before and during construction. The data sets are compared to determine if the track has been affected by construction. If the track has been affected, that data can be used to reestablish the pre-construction conditions. Track monitoring is based on the Class of Track and on tolerances for alignment and surface found in Amtrak MW 1000 Limits and Specifications for Track Maintenance Subpart C – Track Geometry.

Scope of Work

Track monitoring includes:

1. Using surveying methods to establish locations (stations) for collection of track data.
2. Gathering and recording track data before construction starts.
3. Gathering and recording track data at pre-determined time intervals during construction.
4. Comparing pre-construction and during-construction data to determine if differential movement has occurred.
5. Reporting track monitoring data and comparison to Amtrak Construction Project Manager, Assistant Division Engineer of Track and System Track.

Amtrak responsibilities:

1. Prior to construction, Amtrak will provide the Class of Track and determine the number of stations where track data is to be measured.
2. During construction, Amtrak will analyze the data provided and determine the appropriate course of action.

3. Amtrak will be represented by either the Amtrak Construction Project Manager, the Amtrak Assistant Division Engineer of Track or the Amtrak System Track Senior Manager.

Submittal for Amtrak Approval

Design submittals are to be presented to Amtrak System Track for approval at least one month prior to construction.

Proposed track monitoring plans must show either:

1. Where track monitoring points are to be located and the monitoring details or
2. A note on the construction plans stipulating that the Contractor must submit the locations of track monitoring points and the monitoring details.

Contract Surveyors must be licensed to work in the state in which the work is being performed and must be pre-approved by Amtrak Principal Engineer Surveys. Contractor ID card Credentials.

For long-term monitoring, submit prism/target product date, proposed total station(s) location and data collection time intervals.

Execution

Safety: Work performed on track or close enough to foul a track must only be performed under the direction of qualified railroad personnel.

Points Locations or Stations: Track monitoring points shall be established along the track and centered at the point where the work is closest to the track.

Track alignment condition is checked by analyzing the uniformity over short distances on tangents and in curves. Uniformity at any point along the track is established by averaging the measured mid-chord offset values for nine (9) consecutive points centered on that point and which are spaced as follows:

Chord Length = 31 feet, Spacing = 7'-9"

Chord Length = 62 feet, Spacing = 15'-6"

Datum and Accuracy: In accordance with Amtrak Survey Specification, summarized as follows. Horizontal – NAD 83 UTM 18N coordinates in survey feet. Vertical – NAVD 88. Horizontal and vertical accuracy 0.01 feet.

Monitoring Intervals: Track monitoring measurements shall be observed and recorded prior to construction and then at the beginning and end of every shift of work. Points shall be measured,

the measurements recorded, and the numbers compared with previous measurements. All points shall be measured each time monitoring occurs.

Allowable deviations: If track is found to have moved either vertically or horizontally by more than one half of the Amtrak Maintenance limits as specified in Amtrak’s MW-1000 (and as shown in the table below) for the particular class of track involved, then all work shall cease immediately and the construction Contractor shall immediately notify the Amtrak Construction Project Manager, Assistant Division Engineer of Track or System Track Senior Manager. Work may not resume until the designated Amtrak Construction Project Manager has inspected the site and authorized work to restart.

Track Maintenance: Deficiencies in track surface and alignment caused by construction activities will be corrected by Amtrak forces and billed to the construction project.

TRACK CLASS	MAX. PASSENGER SPEED (MPH)	CROSS LEVEL (INCHES) The Difference in Cross Level Between Any Two Points Less Than		DEVIATION FROM UNIFORM PROFILE (INCHES)		DEVIATION FROM HORIZONTAL ALIGNMENT (INCHES)	DEVIATION FROM HORIZONTAL ALIGNMENT (INCHES)
		10'	62'	31' CHORD	62' CHORD	31' CHORD	62' CHORD
MAINTENANCE LIMITS							
1	15	1	2 ¼	N/A	2 ¼	2 ¾	3 ¾
2	30	1	1 ⅝	N/A	2	1 ½	2 ¼
3	60	1	1 ½	N/A	1 ⅝	7/8	1 ¼
4	80	1	1 ¼	N/A	1 ½	¾	1
5	90	1	1 ⅛	N/A	1	¾	½
6	110	¾	1	¾	¾	¾	½
7	125	¾	1	¾	¾	¾	¾
8	160	¾	1	½	¾	¾	¾
9	200	¾	1	¾	½	¾	¾
½ MAINTENANCE LIMITS							
1	15	½	1⅛	N/A	1 ⅛	1 ¾	1 ⅞
2	30	½	13/16	N/A	1	¾	1 ⅛
3	60	½	¾	N/A	13/16	7/16	⅝
4	80	½	⅝	N/A	¾	¾	½
5	90	½	9/16	N/A	½	3/16	¼
6	110	¾	½	¾	¾	3/16	¼
7	125	¾	½	¾	¾	3/16	3/16
8	160	¾	½	¼	¾	3/16	3/16
9	200	¾	½	3/16	¼	3/16	3/16

Date 6/27/19

NOTICE TO CONTRACTOR - TACTILE WARNING STRIP

The installation of the Tactile Warning Strip requires close coordination between the Contractor and the supplier/installer. This coordination is the sole responsibility of the Contractor and there will be no compensation for delays caused by the lack of coordination.

NOTICE TO CONTRACTOR - UNDERGROUND UTILITIES

A portion of the work to be accomplished under this Contract is to be performed within Amtrak's railroad right-of-way. Call-Before-You-Dig (CBYD) does not coordinate the mark out of any underground utilities located within the railroad right-of-way. The Contractor is responsible for coordinating with Amtrak and locating all other utilities throughout the railroad right-of-way prior to performing any excavations.

**NOTICE TO CONTRACTOR - LIMITED SPACE AND AVAILABILITY
OF PARKING**

In order to maintain the maximum number of parking spaces available to commuters at the active station, the Contractor shall restrict its operations to the area(s) shown on the Contract Plans. The Contractor will not be allowed to use any of the available parking spaces for storage of equipment or materials. Further, the Contractor must provide parking spaces for its employees, the employees of its subcontractors, and the Engineer and its employees within the staging area, outside of the limits of operation of the active station.

NOTICE TO CONTRACTOR - MEASUREMENT AND PAYMENT

This Project is being bid with both lump sum and unit price items. The bid items include unit price and lump sum items which are IN ADDITION TO the Major Lump Sum Items (MLSI), of the Project, as follows:

Item No. 0065321A – Rail Facility Upgrade Site No. 1; proposed Windsor station

These separate items will be measured for payment on a unit price or lump sum basis (whichever is applicable) for which a separate bid price is required, at the quantities as indicated in the Bid Proposal Form.

Standard Form 817 Items are referenced by their standard item numbers. Refer to the applicable article of Form 817 for the requirements for these items. Special Provisions included in this Contract are referenced by their item number followed by an "A" suffix. Refer to the Special Provisions contained within this Contract for requirements for these items.

All work depicted on the Contract Plans and described in the Contract Specifications, including mobilization, is included in the MLSI of the Project, with the exception of the unit price or other lump sum items listed on the Bid Proposal Form. Any work that is outside the limits stated under “Method of Measurement” and “Basis of Payment” for a specific item, other than the MLSI, but is shown on the Contract Plans or described in the Contract Specifications, is included in the respective MLSI. Any work that is incidental to an item which is not specifically described or included in the item, but which is required for performance and completion of the work required under the Contract, is included in the respective MLSI.

Vertical Construction Limits

The vertical construction limits are defined as five (5) feet outside of the vertical projection of the edges of the platform, stair and ramp assemblies and five (5) feet (horizontally) outside the face of footing and walls of utility building. The following unit price items will only be measured for payment up to the vertical construction limits:

Item No. 0202000, “Earth Excavation”

Work associated with these items located within the vertical construction limits (as defined above) is included in the respective MLSI.

The following unit price items will be measured for payment, whether or not they are enclosed within the vertical construction limits:

Item No. 0000985A, “Track Monitoring”

Item No. 0209001, “Formation of Subgrade”

Item No. 0811001 “Concrete Curbing”

Item No. 0913984A, “Temporary Protective Fence”

Platform/Site Amenities

There will be no separate payment for platform/site amenities, including, but not limited to recycling and trash receptacles, shelters, etc. The cost of these site amenities, including any hardware and any required excavation and backfill, is included in the respective MLSI.

Signage

There will be no separate payment for signage, including but not limited to station identification signs, kiosks, accessible route signage, tactile signage, schedule holders and other pedestrian wayfinding signs. The cost of these signs, including any hardware, footings, installation and any required excavation and backfill is included in the respective MLSI. Vehicular signage, including directional signage, stop signs and parking signs, including any posts, hardware, footings, installation, and any required excavation and backfill, will be measured for payment on a unit price basis for which a separate bid price is required at the quantities as indicated in the Bid Proposal Form.

Platform Power

There will be no separate payment for the installation of conduit and cable for the communications for lighting, PIDs, trackside phones and/or the public address system. The cost of the conduits, cables, hardware, handholes, junction boxes and/or vaults, and any required excavation and backfill, is included in the respective MLSI.

Electrical Pads and Bases

There will be no separate payment for concrete associated with the fabrication and installation of light pole bases, equipment pads, or for protection of electrical conduit and service entrances. The cost of concrete, including reinforcing, spacers, formwork, excavation and backfill, is included in the respective MLSI.

Electrical

There will be no separate payment for excavation and backfill associated with the installation of site electrical items including, but not limited to; exterior lighting; electrical service, including service to the utility building; video monitoring equipment; internally lit signs; illuminated egress signs; fire alarm components; train approach message boards; communication cable and conduit; or any other site electrical cable, conduit, or service connection component. The cost of excavation for all site electrical items is included in the respective MLSI.

Water Connections

Payment for the hose spigot, hydrant and water line for service to the platforms is defined by the "Vertical Construction Limits" noted above. There will be no separate payment for the excavation, backfill, and materials required for this work enclosed within the "Vertical Construction Limits". The costs for this are included in the respective MLSI. Excavation,

backfill, and materials required for this work not enclosed within the “Vertical Construction Limits” will be measured for payment.

Railroad Grounding/Bonding Connections

There will be no separate payment for necessary components to complete the station grounding and bonding connections, including associated excavation and backfill. The costs for all grounding items are included in the respective MLSI.

NOTICE TO CONTRACTOR - FORM 817 REFERENCES ON STANDARD DRAWINGS

The Contract includes standard Connecticut Department of Transportation drawings with material and pay limit references to Form 817. For work shown on these drawings that is included under the Major Lump Sum Item (MLSI) for the Project, the Contractor shall disregard these references within the Vertical Construction Limits which are defined in Notice to Contractor – Measurement and Payment. Concrete shall comply with the requirements of CSI Specification Section 033000 under the MLSI.

Pay limits for unit price and lump sum items other than the MLSI shall be in accordance with Method of Measurement (Part 4), and Basis of Payment (Part 5) of the appropriate special provision section. Concrete for unit price items other than the MLSI shall be in accordance with Form 817, unless specifically noted otherwise.

NOTICE TO CONTRACTOR - PLATFORM CONSTRUCTION

This project contains platform construction along existing railroad tracks. Where shown on the plans, the approximate centerline of the existing track has been established utilizing data included in the survey performed by the Connecticut Department of Transportation. The existing track centerlines are shown for informational purposes only and are in no way warranted to indicate the as-built conditions in the field. The Contractor shall verify the location of the tracks via a field survey prior to the start of platform construction and shall notify the Engineer immediately of any discrepancies.

The Contractor is advised that the railroad platforms must be constructed to Track Design Specification 63 and specific offset requirements as required by Amtrak to account for curvature in the adjacent track and any superelevation. These requirements are shown on the contract plans and Amtrak Standard Track Plan “Minimum Roadway Clearances” sheets 1 and 2 (dwg. Nos. 700500.001.08 and 700700.002.08) and are detailed below:

At all times during construction of the platforms, the Contractor shall maintain a 5'-7" horizontal offset to the face of the rubrail and a 4'-0" vertical offset from the top of nearest rail.

The Contractor shall develop and submit a “Platform Layout Plan” to the Engineer and Amtrak for review and approval prior to commencing work on the platform construction. The Contractor’s “Platform Layout Plan” shall adhere to Track Design Specification 63 and all offset requirements as required by Amtrak and shown on Amtrak Standard Track Plan “Minimum Roadway Clearances” sheets 1 and 2 (dwg. Nos. 700500.001.08 and 700700.002.08) , noted above, and as shown in the contract plans.

If made available by the Department, the Contractor shall not rely on CADD files for the construction of the railroad platforms and items incidental thereto. At all times, the Contractor shall be bound by the horizontal and vertical offset controls noted above. It is the Contractor’s responsibility to field verify the site conditions, and notify the Engineer of any discrepancies, prior to the start of the platform construction.

The Contractor shall bid the project accordingly.

NOTICE TO CONTRACTOR - LIMITATION OF CONTRACTOR OPERATIONS

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 existing facilities and its occupants for the duration said facilities are to remain in operation.

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 Contractor shall be responsible for paying all monthly electrical usage utility costs related to their construction field office.
2. Telephone Service: The Contractor shall be responsible for paying all monthly telephone utility usage costs related to their construction field office.
3. Sanitary Facilities: The Contractor is responsible for emptying the sanitary facilities at its expense.

The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR - CONSTRUCTION CONTRACTOR **DIGITAL SUBMISSIONS**

Upon execution of the Contract, the Contractor acknowledges and agrees that contractual submittals for this Project shall be submitted and handled through a system of paperless electronic means as outlined in the special provision for Section 1.05 herein.

Shop drawings, working drawings, and product data shall be created, digitally signed and delivered by the Contractor in accordance with the Department's [Contractor Digital Submission Manual](#) (CDSM). The Contractor shall prepare and maintain the contract documentation utilizing either Bentley Systems' Projectwise or Microsoft SharePoint document control system which will be provided by the Department. The specific platform chosen by the Department to be utilized on this project will be announced prior to Contractor Notice to Proceed. The document control system will be physically located in a secure location designated by the Department and the Contractor shall directly access the document control system via the internet. The Department will provide the Contractor the necessary end-user access, contact information, routing details, such as email addresses. The Contractor will also be provided training, a training manual and on-going technical support for the Document Control System. All information that resides on the shared document control system shall become the sole property of the Engineer.

The Department shall not be held responsible for delays, lack of processing or response to submittals that do not follow the specified guidelines in the CDSM.

Refer to ITEM #0969050A – DOCUMENT CONTROL SPECIALIST for more information pertaining to the requirement for a Document Control Specialist who will ensure that the Contractor and all other parties as designated by the Engineer will prepare, status, electronically file and send all project correspondence and drawings utilizing a document control system as established and maintained by the Department.

NOTICE TO CONTRACTOR - FM GLOBAL SUBMITTALS

Copies of the following submittal(s), requiring FM Global review for conformance with the Contract, shall be transmitted to the Designer in accordance with NOTICE TO CONTRACTOR-SUBMITTALS. Review of the following submittals may take up to 60 days in accordance with Form 817 Article 1.20-1.05.02.

1. FM Global Form 2688 *Application for Acceptance of Roofing Systems*
2. FM Global Form 85B, Contractor's Material and Test Certificate for underground piping should be completed and submitted to FM Global.
3. CSI Section 238240 – DX Mini-Splits System
4. CSI Section 283101 – Fire Alarm System
5. CSI Section 042113 – Brick Masonry
6. CSI Section 061600 - Sheathing
7. FM Global Property Loss Prevention Data Sheet 1-31 Metal Roofing Systems for the formed metal roof. Detailed drawings and calculations including the manufacturer, and insulation, will accompany the Property Loss Prevention Data Sheet.

The above list may not be all-inclusive and does not relieve the Contractor from its responsibility to provide CTDOT and/or AMTRAK other submittals for approval as may be required elsewhere in the Contract Drawings.

NOTICE TO CONTRACTOR - ENVIRONMENTAL INVESTIGATIONS

Environmental site investigations have been conducted that involved the sampling and laboratory analysis of soil collected from various locations and depths within the Project limits. The results of these investigations indicated the presence of detectable concentrations of semi-volatile organic compounds (SVOCs) and pesticides in the soils within proposed construction areas in exceedance of Connecticut Department of Energy and Environmental Protection (CT DEEP) numeric criteria. The presence of these compounds at these concentrations will require the disposition of soils excavated from these areas to be restricted as described herein. Based on these findings, two (2) AOECs exist within the proposed Project limits.

Material excavated from the AOECs that cannot be reused within the Project limits will require disposal at an approved treatment/disposal facility in accordance with Item No. 0202315A - Disposal of Controlled Materials. The DEEP groundwater classification beneath the site is GB.

The Contractor is hereby notified that controlled materials requiring special management 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 AOECs. 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 IS SOLELY THE RESPONSIBILITY OF THE CONTRACTOR.

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

All suitable material excavated within the AOECs shall be utilized as fill/backfill within the AOECs 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; (3) the DEEP groundwater classification of the area where the soil is to be reused as fill does not preclude said reuse; and (4) such soil is not placed in an area subject to erosion.

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

- Item No. 0101000A - Environmental Health and Safety
- Item No. 0101117A - Controlled Materials Handling
- Item No. 0202315A - Disposal of Controlled Materials

The Contractor is alerted to the fact that a Department environmental consultant will be on site for excavation activities within the AOECs, to collect soil samples (if necessary), and to observe site conditions for the State. **The WSA on the plans is to be used exclusively for temporary stockpiling of excavated materials from within the Project AOECs for determination of disposal classification.**

Information pertaining to the results of the environmental investigations discussed can be found in the documents listed below. The results contained in the environmental investigation reports listed below show levels of various contaminants that the Contractor may encounter during construction. Actual levels found during construction may vary and such variations will not be considered a change in condition provided the material can still be disposed as non-hazardous at one or more of the disposal facilities listed in Item No. 0202315A - Disposal of Controlled Materials. These documents shall be available for review electronically.

- **Soil Investigation Analytical Results Summary, Windsor Short High-Level Platform Station, New Haven – Hartford – Springfield Rail Program; HRP Associates, Inc.; September 4, 2019.**

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* are herein revised to reflect changes to item names and nomenclature for standard Portland Cement Concrete (PCC) mix classifications. Other Special Provisions, standard specifications, 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 PCCXXYZ 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 (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 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 - TRAINING

The Contractor shall provide training on products specified in the following Contract provisions:

1. Ethernet Switch – Cisco IE3200
2. Ethernet Switch – Cisco IE5000
3. Ethernet Switch – Cisco C2960XR
4. Ethernet Switch – Cisco 4503E
5. Video Encoder
6. Workstations
7. Video Management System
8. Fixed Mount Dome Camera
9. CCTV Cabinet – Base Mounted
10. Remote CCTV Cabinet
11. 60W PoE Injector
12. PoE Surge Protection Chassis – Rack Mount
13. PoE Surge Protection Chassis – Wall Mount
14. PoE Surge Protection Module
15. Cisco Network Management System
16. Video Wall System
17. Video Decoder
18. Video Decoding Workstation
19. Console Workstation
20. Time Server
21. Security Node House
22. Standby Generator
23. Automatic Transfer Switch
24. CACP/FACP
25. Uninterruptable Power Supply

The above list may not be all inclusive and does not relieve the Contractor from his responsibility to provide training for all system elements or training that is required under other Contract provisions.

Training Program General Requirements:

A Training Program shall be provided by the Contractor in order to provide initial and ongoing training for all users of the CCTV System. The Contractor shall provide videos on DVD of all Contractor-provided training sessions to facilitate the ongoing training. Training shall include ALL components of the CCTV system including (but not limited to) head-end, cameras, field

panels and equipment, communications network, encoders, and IR illuminators and shall include site-specific information. The training shall be tailored to the functions and configuration of the final system as furnished by the Contractor.

Submit Training Plan for approval by the Engineer. After approval of the Training Plan, the Contractor shall conduct the specified training. The training program shall be implemented through the use of formal classroom training and/or other forms of presentation as recommended by the Contractor. The curriculum shall be designed so that each group of trainees shall be trained in the full repertoire of system commands which they may have to use in the course of performing their designated functions. Students shall be provided with complete sets of training materials and operating manuals during the training sessions, which they shall retain for use on the job at the completion of training. Formal training shall also include a comprehensive student testing program for determining that the intended training has been successfully imparted.

Contractor shall develop and implement a training database configuration to train staff on the use of the system. This training configuration should address the functions and operation of the CCTV System, in real-time simulation of typical alarm events. To support this project, a test database shall be created which shall remain available for centralized training after the system is in operation. The test database configuration shall not degrade the performance of the CCTV System.

Contractor shall conduct the required training at the facility, at the scheduled times and location designated by the Engineer consistent with the approved Training Plan. The full complement of training courses shall be conducted over time to accommodate shift personnel, vacations, and make-up sessions. A detailed schedule for the delivery of all training shall be included in the Project Plan and Schedule and reported on during the regularly scheduled status meetings. All training shall be completed no later than 14 calendar days prior to commencement of the 31-day operational test unless otherwise coordinated with the Engineer. The training shall include, but not be limited to the following groupings of staff:

1. Operator training shall include a simulation of actual site conditions at each facility and shall be provided for three groups of 15 students per course/per facility. Each group shall be trained for the equivalent of two eight hour instructional classes (training must be flexible to accommodate shift workers). Training shall include, but not be limited to: sequence of operation review; sign-on/sign-off; selection of all displays and reports; commanding of points, English and graphic mode; modifying English text; selection of all alarm functions; temporarily modifying resolution and frame rate for viewing; reviews of all topics presented in the Operator's Manual. Training shall also provide site-specific information about the newly installed components and demonstration of the new

system with particular emphasis of components or settings that are different from previous phases.

2. System Administrator Training shall include, in addition to subjects addressed in the operator training classes, training for two groups of six CTDOT or AMTRAK supervisors per facility. Each group shall be trained for two, eight hour instructional classes to be held on two separate days. Training shall include, but not be limited to: communications system instruction; use of operator terminal; program upload, download modification; password assignment and modification; operator assignment and modification; point disable/enable; terminal and data segregation/modification; sequence of operation and flowcharts; modification of control programs and databases; add/delete/modify data points; review of all topics presented in the System Administrator's Manual. Training shall also provide site-specific information about the newly installed components and demonstration of the new system with particular emphasis of components or settings that are different from previous phases.
3. Maintenance Training shall include training for two groups of six students per course, per facility. Each group shall be trained for four, eight hour instructional classes to be held on four separate days. System maintenance training shall include all functions required to maintain the System and to prepare maintenance personnel to make minor adjustments to the System, troubleshoot the System at the board level, replace defective components and field devices, and perform other maintenance functions normally associated with board-level maintenance activities. This shall include, at a minimum, component overview, safety, troubleshooting, programming, adjustments, and maintenance requirements of the following:
 - a. Overall system and architecture
 - b. System components
 - c. CCTV cabinets
 - d. CCTV cameras
 - e. Head-end systems
 - f. Power supplies and power injectors
 - g. Network architecture and network equipment

Training shall include symptom recognition, shut down and start-up procedures, replacement of all devices and subcomponents including cameras, lenses, housings, power supplies, switches, etc.

Training shall also provide site-specific information about the newly installed components and demonstration of the new system with particular emphasis of components or settings that are different from previous phases.

Upon completion of each training program, the Contractor shall prepare and deliver a training

report which shall summarize the results of the training program, including a list of attendees, course evaluation form, and recommendations for follow-up training or modification to the curriculum.

The Contractor shall furnish electronic copies (both native and PDF formats) of all materials used during the training. The PDF versions shall be created electronically and not scanned from a printed copy. Furnish to the Engineer five (5) file sets each of the User Manual slides, coursework, and training aids in addition to providing an appropriate manual for each person attending the classes.

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 conformance with Standard Specifications (Supplemented July 2019) Article 1.05.03 – “Conformity with Plans and Specifications (including Quality Control).”

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 - 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 ≥ 5 on 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 coating²	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 sealer²	--- ¹	500
Reactive penetrating sealer²	--- ¹	350
Recycled coating	250	250
Roof coating	250	250
Rust preventive coating²	400	250
Shellac Clear	730	730
Shellac Opaque	550	550
Specialty primer, sealer and undercoater²	350	100
Stain	250	250
Stone consolidant²	--- 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 coating²	--- ¹	275
Wood preservative	350	350
Zinc-rich primer²	--- 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 ≥5 on 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

NOTICE TO CONTRACTOR - PROCUREMENT OF MATERIALS

Upon award, the Contractor shall proceed with shop drawings, working drawings, procurement of materials, and all other submittals required to complete the work in accordance with the contract documents.

NOTICE TO CONTRACTOR - RIGHTS OF WAY RESTRICTIONS

The Contractor is hereby advised that at the time of advertising for bids not all the property may be acquired by the State, certain residences and/or business establishments had not been vacated, and asbestos removal by others from buildings to be disposed of had not been completed. A complete listing of the affected properties and the anticipated dates that they will become available is hereinafter provided. The Contractor is further advised that limitations, as enumerated herein below, are imposed which may interfere with the physical construction of the project. Following are statements which will set forth the restrictions on the right of entrance to property and conditions governing construction of the project.

1) The Contractor shall not occupy properties that are unacquired, perform any work thereon, or inhibit access thereto until the properties have been acquired and right of possession has been obtained. If the Contractor is allowed to proceed with the physical construction of the project, no action will be taken that will result in unnecessary inconvenience such as the discontinuance of utilities, the prevention of ingress and egress to the property, or will result in disproportionate injury or any action coercive in nature to occupants of residences (businesses, farms, or non-profit organization) who have not yet moved from the right-of-way.

2) It should be anticipated that each of the properties listed herein may be considered to have an effect upon construction operations.

3) The Contractor shall be aware that extensions of time will be granted, if necessary, for delays in construction operations caused by continued occupancy of residences, properties being unacquired or asbestos abatement concluding beyond the estimated time period.

The following is a complete listing of properties which have not been acquired, vacated and asbestos abated as of February 5, 2020 with the anticipated dates such properties will be acquired and/or vacated and abated.

<u>Property Map Serial Nos.</u>	<u>Anticipated Acquisition Date</u>
9 (Utility Easement)	May 20, 2020
9 (Construction Easement)	May 20, 2020
2 (Construction Easement)	May 20, 2020
10 (Construction Easement-private)	May 20, 2020
7 (Amtrak Lease Map 1)	May 20, 2020
7 (Amtrak Lease Map 2)	May 20, 2020

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 1.02 - PROPOSAL REQUIREMENTS AND CONDITIONS

Article 1.02.04 – Examination of Plans, Specifications, Special Provisions and Site of Work:

Replace the third sentence of the last paragraph with:

The Department cannot ensure a response to inquiries received later than ten (10) days prior to the original scheduled opening of the related bid.

SECTION 1.03 - AWARD AND EXECUTION OF CONTRACT

Article 1.03.02 - Award and Execution of Contract:

After the second sentence of the only paragraph add the following:

The successful bidder is hereby notified of the Department's intent to award this contract within 44 days of the bid opening.

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, however, the contractor is hereby put on notice that it is the Department's intent to issue the Notice to Proceed no later than 31 calendar days after the date of the execution of the Contract by the Department.

SECTION 1.08 - PROSECUTION AND PROGRESS

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:

REQUIRED BEST MANAGEMENT PRACTICES

Add the following after Required Best Management Practice Number 13:

14. The Contractor is hereby notified that the State listed species of Special Concern eastern box turtle (*Terrapene carolina carolina*), is present within the Project limits. In Connecticut, this terrestrial turtle lives in a variety of habitats, including woodlands, field edges, thickets, marshes, bogs, and stream banks. Typically however, eastern box turtles are found in well-drained forest bottomlands and open deciduous forests. They will use wetland areas at various times during the season. During the hottest part of a summer day, they will wander to find springs and seepages where they can burrow into the moist soil. Eastern box turtles overwinter in upland forest, typically covered by leaf litter or woody debris. As temperatures drop, the turtles burrow down into soft ground.

All construction activities taking place within the Project limits will need to be coordinated with the Office of Environmental Planning (OEP) through the Engineer. At least 10 days prior to the commencement of any construction activities, the Contractor shall, through the Engineer, arrange for a CT DOT Environmental Inspector from the OEP or their authorized delegate to meet and discuss proper protocol for maintaining environmental commitments made for the protection of this species and habitat. OEP will provide oversight through the Engineer to ensure that the following protocols are followed and maintained during the course of the Project.

For any work done during the eastern box turtle's active period (April 1 to October 31) the Department will require the following precautionary measures to protect the eastern box turtle and eastern box turtle habitat:

- a. All areas within the Project limits must be surveyed and cleared of any turtles immediately prior to the commencement of initial clearing and grubbing activities.
- b. All construction personnel working within eastern box turtle habitat must be apprised of the species description and the possible presence of this listed species.
- c. Exclusionary practices will be required in order to prevent any eastern box turtle access to construction areas. These measures will need to be installed at the limits of disturbance as shown on the plans.
- d. Exclusionary fencing shall be at least 20" tall and must be secured to and remain in contact with the ground. It shall be regularly inspected / maintained to prevent any gaps or openings at ground level. Standard silt fence is adequate; fencing with netting shall not be used.

- e. The Contractor must search the work area each morning for the presence of this listed species prior to any work being done.
- f. Any eastern box turtles encountered within the immediate work area shall be carefully moved to an adjacent area outside of the excluded area and the Engineer shall be immediately informed in order to contact OEP with the location.
- g. All staging and storage areas in the vicinity of turtle habitat, outside of previously paved locations, regardless of the duration of time they will be utilized, must be reviewed by and receive written approval from OEP through the Engineer.
- h. No heavy machinery or vehicles may be parked in any unapproved eastern box turtle habitat.
- i. Exclusionary fencing shall be removed when it is no longer needed, and silt fence shall be removed as soon as the area is stable to allow for reptile and amphibian passage to resume.

Work may take place during the eastern box turtle's inactive (hibernation) period (November 1 to March 31) with the following additional precautionary measure:

- a. Exclusionary fencing must be installed and the area inspected for turtles by the Engineer or Engineer's approved representative prior to October 1.

These practices will be applied to the entire Project unless a sketch is attached, which identifies specific areas of concern.

This species is protected by State laws, which prohibit killing, harming, taking, or keeping them in your possession. Photographs and the laws protecting eastern box turtles shall be posted in the Contractor's and DOT field offices (species ID sheets will be provided by OEP).



Connecticut Department of
**ENERGY &
ENVIRONMENTAL
PROTECTION**

December 30, 2019

Mr. Christopher Samorajczyk
Connecticut Department of Transportation
2800 Berlin Turnpike
Newington, CT 06131-7546
christopher.samorajczyk@ct.gov

Project: CTDOT Project No. 320-19, Addition of ADA Boarding Platforms and Utility Building at Windsor Train Station in Windsor, Connecticut
Request No.: 201914720

Dear Christopher Samorajczyk,

I have reviewed Natural Diversity Data Base maps and files regarding the area delineated on the map you provided for the proposed CTDOT Project No. 320-19, Addition of ADA Boarding Platforms and Utility Building at Windsor Train Station in Windsor, Connecticut. According to our information there are known extant populations of State Special Concern eastern box turtle (*Terrapene carolina carolina*) that occur within your project boundaries.

I concur with your proposed environmental compliance best management practices that include the conservation and protection of State Special Concern eastern box turtle (*Terrapene carolina carolina*). I concur that by utilizing your proposed best management practices and protection protocols that the proposed activities will lessen the impact on the turtle.

This determination is good for two years. Please re-submit an NDDB Request for Review if the scope of work changes or if work has not begun on this project by December 30, 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.

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,

A handwritten signature in cursive script that reads 'Dawn M. McKay'.

Dawn M. McKay
Environmental Analyst 3



Eastern Box Turtle

Connecticut Species of Special Concern

Scientific Name: *Terrapene carolina carolina*

Size: 5-8 inches (12.7-20 cm) in length

Habitat Type:

Deciduous woodlands, old fields, pastures, and marshy areas

Colorations:

- The carapace (top of shell) background color is brown to brownish black with a strong pattern of numerous lines, irregular blotches and bars that vary from yellow to bright orange.
- The plastron (bottom of chest plate) has a wide range of colors from immaculate yellow-brown, dark brown, brownish black to black.
- The pattern of the plastron varies from: dark blotches; a dark central blotch that becomes lighter along the margins; a dark central blotch that branches along the seams; or radiating light lines.
- The head, neck, legs, and tail are dark brown and are usually heavily patterned with yellow to orange streaks, blotches, and bars.
- Males usually have red eyes and a concave plastron and females have brown eyes and a flat plastron.

Characteristics:

- Small terrestrial species.
- Side View – The carapace is high-domed and slightly keeled.
- Above View – The carapace is oblong with slight flaring on the posterior margins.
- The plastron is extremely broad and as long as or longer than the carapace.
- The legs are well-developed and strong and feet are webbed at the base.
- The upper jaw is hooked terminally and has no notch.

If any Eastern box turtles are observed in or around the project area the Office of Environmental Planning must be notified at 860-594-2937 or 860-594-2938. If OEP staff cannot be reached at either of the above referenced phone numbers, the District environmental coordinator will need to be contacted to facilitate further coordination with OEP's Water and Noise Compliance Unit.

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:

<p>[Addressed to:]</p> <p>Commissioner of Transportation Department of Transportation P.O. Box 317546 Newington, Connecticut 06131-7546</p> <p>Project Title and Number</p> <p>[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.</p> <p>[Signature:] [Name of authorized signatory] [Title]</p>
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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:

Time Period: Start of Construction to October 31, 2014

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.

Time Period: November 1, 2014 to March 31, 2015

Block heater receptacles shall be operational. The Contractor shall continue building construction/renovation and site work.

Time Period: April 1, 2015 to End of Construction

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."

SECTION 6.01 - CONCRETE FOR STRUCTURES

Replace Section 6.01 in its entirety with the following:

6.01.01—Description

6.01.02—Materials

6.01.03—Construction Methods

6.01.04—Method of Measurement

6.01.05—Basis of Payment

6.01.01—Description: This item shall include concrete for use in new construction, surface repair or structural repair of bridges and culverts, walls, catch basins, drop inlets and other incidental construction. The concrete shall be composed of Portland cement, pozzolans, fine and coarse aggregate, admixtures and water, prepared and constructed in accordance with these specifications, at the locations and of the form dimensions and class shown on the plans, or as directed by the Engineer.

The use of concrete from dry batch or central mixed plants is permitted for all concrete mixtures.

6.01.02—Materials: The materials for this work shall meet the requirements of M.03. Surface or structural repair concrete shall be documented on the delivery ticket, as required in 6.01.03-II-3(a), as having the plastic properties necessary for confined placement to ensure appropriate workability for consolidation within the forms.

6.01.03—Construction Methods:

I. Concrete Quality Control (QC) Requirements: For all bridge deck and bridge parapet construction, the Contractor must demonstrate to the Engineer that the materials and work that will be provided by their field staff, subcontractors, and suppliers meets Contract specification requirements.

This effort shall be documented with a **Concrete Quality Control Plan (CQCP)** and shall address the communication with all parties, on-site inspection, sampling and testing frequency necessary to keep the production, placement and finishing operations in control, to determine when an operation has gone out of control and anticipated procedure to correct the situation in a timely manner.

1. General – provide an overview of the means and methods anticipated to perform the work including any anticipated conditions that may need additional attention (such as seasonal conditions requiring heating or cooling of concrete)
2. Contractor Organization – address authority levels/duties by position and name of persons holding those positions; include those who have decision making authority with regard to quality control, materials, sampling and testing who can be contacted by the Engineer
3. Concrete Mix Design – identify concrete supplier(s); provide copies of all applicable mix designs to field staff; and address submittal timeframe
4. Transportation and Delivery of Concrete – identify the supplier’s plant capacity and ability to ensure continuous delivery to the Project to meet the requirements of the mix design and a corrective procedure if it does not meet Project requirements; include a provision for the addition of admixtures and follow up testing
5. Placement and Finishing of Concrete – identify and describe:

- (a) placement equipment
 - (b) placement method(s) to be used (chute, pump, hopper or other)
 - (c) starting point and direction of placement (logistical sequencing)
 - (d) slip forming, formwork, stay-in-place forms or other forming method(s)
 - (e) joint construction method(s)
 - (f) process and documentation that the elevations, base, forms, reinforcement (including support chairs and ties), utility inserts or any other appurtenance installations have been inspected by the Contractor prior to concrete placement
 - (g) equipment and method(s) to be used for vibrating and consolidating concrete
 - (h) procedure for verifying adequate consolidation and how segregation will be addressed
 - (i) schedule and method(s) to be used for finishing all exposed surfaces
6. Curing of Concrete – describe schedule and method(s) for curing of concrete and how the method(s) will be monitored and maintained
7. Contractor QC testing – identify person(s) or firms responsible for Contractor QC testing and provide copies of their certification(s) (see 6.01.03-II-5), and testing facility location(s). In addition, describe the process used for communication between the QC testing personnel and the Contractor project staff; describe what measures will be taken when test results are out of compliance; this shall include what increased frequency of testing is to be performed to verify that concrete properties are in compliance; the threshold at which time placement ceases; describe what protective measures will be used in case of unforeseen weather
8. The CQCP shall include the name and qualifications of a Quality Control Manager (QCM) provided by the Contractor. The QCM shall be responsible for the administration of the CQCP, and any modifications that may become necessary. The QCM shall have the ability to direct all Contractor personnel on the Project during concreting operations and must communicate directly with the concrete supplier. The QCM shall be certified as either a **Concrete Transportation Construction Inspector by the American Concrete Institute (ACI)** or a **NETTCP Concrete Inspector**.
9. The CQCP must include a provision for pre-placement meeting(s) to be held with representatives of the Engineer, the concrete supplier, the QCM and the Contractor’s field staff supervising the work.
- (a) Timing and number of the meeting(s) will be determined by the complexity of the mix design or placement.
 - (b) Non-Standard mix designs that require trial placements will be discussed at the Preconstruction Meeting to remind the Contractor of the time needed for testing. Additional meeting(s) should be scheduled at least 90 days prior to first use of non-standard mix designs, to allow suppliers to perform trial batches and testing.
 - (c) Discussions shall include the configuration and specific application that the concrete will be used for, plastic properties and workability, any mix design challenges, trial placement procedures and subsequent trial results, timing and quantities. Refer to 6.01.03-II-6(e) for additional requirements.
10. The CQCP shall be submitted to the Engineer and concrete supplier for review and comment a minimum of 30 days prior to production or placement. Production and placement shall not occur until all comments of the Engineer and supplier have been addressed by the Contractor. Changes to the CQCP based on data not available at time of submittal may be added via addendum.

11. The Contractor shall provide the Engineer QC test results within 48 hours after testing or inspection in a format acceptable to the Engineer. The Contractor shall also maintain complete records of all QC tests.

Review of the CQCP does not relieve the Contractor of its responsibility to comply with the Project specifications. The Contractor may modify the CQCP as work progresses and must document the changes in writing prior to resuming operations. These changes include but are not limited to changes in quality control procedures or personnel.

II. New Construction:

1. Falsework and Forms: Falsework is considered to be any temporary structure which supports structural elements of concrete, steel, masonry or other material during the construction or erection. Forms are to be considered to be the enclosures or panels which contain the fluid concrete and withstand the forces due to its placement and consolidation. Forms may in turn be supported on falsework.

This work shall consist of the construction and removal of falsework and forms that are designed by the Contractor in the execution of the work, and whose failure to perform properly could adversely affect the character of the Contract work or endanger the safety of adjacent facilities, property, or the public. Forms shall be mortar tight. Forms and falsework shall be of sufficient rigidity and strength to safely support all loads imposed and to produce in the finished structure the lines and grades indicated in the Contract documents. Forms shall also impart the required surface texture and rustication and shall not detract from the uniformity of color of the formed surfaces. Forms shall be made of wood, steel or other material approved by the Engineer.

(a) Design: The design of falsework and formwork shall conform to the *AASHTO Guide Design Specifications for Bridge Temporary Works*, or to other established and generally accepted design codes such as ACI Standard *ACI 347-Recommended Practice for Concrete Formwork* or specific form or falsework manufacturer specifications. When other than new or undamaged materials are used, appropriate reductions in allowable stresses, and decreases in resistance factors or imposed loads shall be used for design.

(b) Loads: The design of the falsework and forms shall be based on load factors specified in the *AASHTO LRFD Bridge Design Specifications* and all applicable load combinations shall be investigated. The design load for falsework shall consist of the sum of appropriate dead and live vertical loads and any horizontal loads.

As a minimum, dead loads shall include the weight of the falsework and all construction material to be supported. The combined unit weight of concrete, reinforcing and pre-stressing steel, and forms that is supported shall be assumed to be not less than:

1. Normal-weight concrete: 0.16 kip/ft³
2. Lightweight concrete: 0.13 kip/ft³

Live loads shall consist of the actual weight of any equipment to be supported, applied as concentrated loads at the points of contact and a uniform load of not less than 0.02 kip/ft² applied over the area supported, plus 0.075 kip/ft applied at the outside edge of deck overhangs.

The horizontal load used for the design of the falsework bracing system shall be the sum of the horizontal loads due to equipment; construction sequence including unbalanced hydrostatic forces from fluid concrete and traffic control devices; stream flow, when

applicable; and an allowance for wind. However, in no case shall the horizontal load to be resisted in any direction be less than 2% of the total dead load.

For post-tensioned structures, the falsework shall also be designed to support any increase in or redistribution of loads caused by tensioning of the structure. Loads imposed by falsework onto existing, new, or partially completed structures shall not exceed those permitted in 6.01.03-II-12, Application of Loads.

- (c) **Working Drawings:** The working drawings for falsework and formwork shall be prepared in accordance with 1.05.02 whenever the falsework or formwork exceeds 14.0 feet high or whenever vehicular, marine, or pedestrian traffic may travel under or adjacent to the falsework or formwork. Working drawings shall include the sequence, method and rate of placement of the concrete.

Manufacturer catalog cuts or written installation procedures shall be provided for any clips, braces, hangers or other manufactured parts used with the formwork or falsework.

- (d) **Construction:** Forms and falsework shall be built true to lines and grades shall be strong, stable, firm, mortar-tight and adequately braced or tied, or both. They shall be designed and constructed to withstand all loads and pressures including those imposed by plastic concrete, taking full account of the stresses due to the rate of placement, effect of vibration and conditions brought about by construction methods. Forms and falsework shall be constructed to compensate for variations in camber of supporting members and allow for deflections.

Falsework and formwork shall be chamfered at all sharp corners, unless otherwise ordered or permitted, and shall be given a slight bevel or draft in the case of projections to ensure satisfactory removal. Materials for falsework and formwork and their supports, ties and bracing, shall be of the type, quality and strength to achieve the structural requirements. Form material in contact with concrete shall provide the finished concrete surface smoothness as specified in 6.01.03-II-10, Finishing Concrete Surfaces, and shall have a uniform appearance.

Falsework and formwork shall be treated with form oil or other release agent approved by the Engineer before the reinforcing steel is placed or self-releasing forms approved by the Engineer may be used. Release agents which will adhere to or discolor the concrete shall not be used.

Falsework and formwork for concrete surfaces exposed to view shall produce a smooth surface of uniform texture, free of voids, indentations, protrusions and bulges. Panels lining falsework and formwork shall be arranged so that the joint lines form a symmetrical pattern conforming to the general lines of the structure. The same type of form-lining material shall be used throughout each element of a structure. Falsework and formwork shall be sufficiently rigid so that the undulation of the concrete surface shall not exceed 1/4 inch when checked with a 4 foot straightedge or template.

For non-exposed surfaces the falsework and formwork shall be sufficiently rigid so that the undulation of the concrete surface shall not exceed 1/2 inch when checked with a 4 foot straightedge or template.

Metal ties and anchors to hold the falsework and formwork in alignment and location shall be so constructed that the metal work can be removed to a depth of at least 2 inches from the concrete surface without damage to the concrete. All cavities resulting from the removal of metal ties shall be filled after removal of forms with cement mortar of the same

proportions used in the body of the work or other materials approved by the Engineer, and the surface finished smooth and even, and if exposed in the finished work, shall be similar in texture and color of adjacent surfaces. With permission of the Engineer, the Contractor need not remove from the underneath side of bridge decks portions of metal devices used to support reinforcing steel providing such devices are of material, or are adequately coated with material, that will not rust or corrode. When coated reinforcing steel is required, all metal ties, anchorages, or spreaders that remain in the concrete shall be of corrosion-resistant material or coated with a dielectric material.

Forms shall be clean and clear of all debris. For narrow walls and columns where the bottom of the form is inaccessible, an access opening will be allowed in the form and falsework for cleaning out extraneous material.

(e) Vacant

- (f) Bridge Decks:** After erection of beams and prior to placing falsework and forms, the Contractor shall take elevations along the top of the beam at the points shown on the plans or as directed by the Engineer. The Contractor shall calculate the haunch depths and provide them to the Engineer a minimum of 7 days prior to installing the falsework and forms. The Contractor shall also provide calculations for the setting of the overhang brackets based on the final beam deflection. These calculations shall be based on the final proposed deck grade and parapet elevations.

Falsework or formwork for deck forms on girder bridges shall be supported directly on the girders so that there will be no appreciable differential settlement during placing of the concrete. Girders shall be either braced and tied to resist any forces that would cause rotation or torsion in the girders caused by the placing of concrete for diaphragms or decks, or shown to be adequate for those effects. Unless specifically permitted, welding of falsework support brackets or braces to structural steel members or reinforcing steel shall not be allowed.

- (g) Stay-In-Place Metal Forms for Bridge Decks:** These forms may be used if shown in the Contract documents or approved by the Engineer. Prior to the use of such forms and before fabricating any material, the Contractor shall submit working drawings to the Engineer for review in accordance with 1.05.02. These drawings shall include the proposed method of form construction, erection plans including placement plans, attachment details, weld procedure(s), material lists, material designation, gage of all materials, and the details of corrugation. Also, copies of the form design computations shall be submitted with the working drawings. Any changes necessary to accommodate stay-in-place forms, if approved, shall be at no cost to the Department.

The metal forms shall be designed on the basis of the dead load of the form, reinforcement and the plastic concrete, including the additional weight of concrete [considered to be equivalent to the weight imposed by an additional concrete thickness equal to 3% of the proposed deck thickness, but not to exceed 0.3 inch] due to the deflection of the metal forms, plus 50 psf for construction loads. The allowable stress in the corrugated form and the accessories shall not be greater than 0.725 times the yield strength of the furnished material and the allowable stress shall not exceed 36,000 psi. The span for design and deflection shall be the clear distance between edges of the beams or girders less 2 inches and shall be measured parallel to the form flutes. The maximum deflection under the weight of plastic concrete, reinforcement, and forms shall not exceed 1/180 of the form

span or 0.5 inches, whichever is less. In no case shall the loading used to estimate this deflection be less than 120 psf. The permissible form camber shall be based on the actual dead load condition. Camber shall not be used to compensate for deflection in excess of the foregoing limits. The form support angles shall be designed as a cantilever and the horizontal leg of the form support angle shall not be greater than 3 inches.

No stay-in-place metal forms shall be placed over or be directly supported by the top flanges of beams or girders. The form supporting steel angles may be supported by or attached to the top flanges.

Stay-in-place metal forms shall not be used in bays where longitudinal slab construction joints are located, under cantilevered slabs such as the overhang outside of fascia members, and bridges where the clearance over a salt-laden body of water is less than 15 feet above mean high water level.

Welding to the top flanges of steel beams and girders is not permitted in the areas where the top flanges are in tension, or as indicated on the plans. Alternate installation procedures shall be submitted addressing this condition.

Drilling of holes in pre-stressed concrete beams or the use of power-actuated tools on the prestressed concrete beams for fastening of the form supports to the pre-stressed concrete beams will not be permitted. Welding of the reinforcing steel to the pre-stressed units is not permitted.

All edges of openings cut for drains, pipes, and similar appurtenances shall be independently supported around the entire periphery of the opening. All fabricated stay-in-place metal forms shall be unloaded, stored at the Project Site at least 4 inches above the ground on platforms, skids or other suitable supports and shall be protected against corrosion and damage and handled in such a manner as to preclude damage to the forms. Damaged material shall be replaced at no additional cost to the State.

Any exposed form or form support metal where the galvanized coating has been damaged, shall be thoroughly cleaned, wire brushed, then coated with 2 coats of Zinc Dust – Zinc Oxide primer, FS No. TT-P-641d, Type II or another product acceptable to the Engineer.

The forms shall be installed from the topside in accordance with the manufacturer's recommended installation procedures. The form supports shall ensure that the forms retain their correct dimensions and positions during use at all times. Form supports shall provide vertical adjustment to maintain design slab thickness at the crest of corrugation, to compensate for variations in camber of beams and girders and to allow for deflections. Stay-in-place metal forms shall have a minimum depth of the form valley equal to 2 inches. The forms shall have closed tapered ends. Lightweight filler material shall be used in the form valleys.

All field cutting shall be done with a steel cutting saw or shears including the cutting of supports, closures and cutouts. Flame cutting of forms is not permitted.

All welding shall be performed by Department-certified welders in accordance with the Welding subarticle in 6.03. Welding of forms to supports is not permitted.

The steel form supports shall be placed in direct contact with the flange of stringer or floor beam flanges and attached by bolts, clips, welding where permitted, or other approved means. Form sheets shall not be permitted to rest directly on the top of the stringer or floor beam flanges. The forms shall be securely fastened to form supports with self-drilling fasteners and shall have a minimum bearing length of 1 inch at each end. In the areas

where the form sheets lap, the form sheets shall be securely fastened to one another by fasteners at a maximum spacing of 18 inches. The ends of the form sheets shall be securely attached to the support angles with fasteners at a maximum spacing of 18 inches or 2 corrugation widths, whichever is less.

The depth of the concrete slab shall be as shown on the plans and the corrugated forms shall be placed so that the top of the corrugation will coincide with the bottom of the deck slab. No part of the forms or their supports shall protrude into the slab. All reinforcement in the bottom reinforcement mat shall have a minimum concrete cover of 1 inch unless noted otherwise on the plans.

The completed stay-in-place metal form system shall be sufficiently tight to prevent leakage of mortar. Where forms or their installation are unsatisfactory in the opinion of the Engineer, either before or during placement of the concrete, the Contractor shall correct the defects before proceeding with the work.

- (h) **Construction Joints:** Construction joints other than those shown on the plans will not be permitted without prior approval of the Engineer. In joining fresh concrete to concrete that has already set, the work already in place shall have all loose and foreign material removed, and the surface roughened and thoroughly drenched with water.

All reinforcing steel shall extend continuously through joints. Where unplanned construction joints may be needed, they shall be constructed as directed by the Engineer.

- (i) **Expansion and Contraction Joints:** Expansion and contraction joints shall be constructed at the locations and in accordance with the details specified in the Contract. The forming of joint openings shall be dimensioned in accordance with the joint manufacturer's design requirements. Joints include open joints, filled joints, joints sealed with sealants, joints reinforced with steel armor plates or shapes, paraffin coated joints, and joints with combinations of these features.

Open joints shall be placed at locations designated on the plans and shall be formed by the insertion and subsequent removal of templates of wood, metal or other suitable material. The templates shall be so constructed that their removal may be readily accomplished without damage to the work.

Filled joints shall be made with joint filler, the materials for which shall meet the requirements of the plans and of these specifications.

For mechanical joint systems, the concrete shall be placed in such a manner that does not interfere with the movement of the joint.

- (j) **Pipes, Conduits and Utility Installations:** The Contractor shall coordinate the installation of pipes, conduits and utilities as shown on the plans and in accordance with the Contract or as directed by the Engineer. The openings accommodating such pipe, conduit and utility installations shall be incorporated into the formwork by the Contractor.
- (k) **Anchorage:** Anchor bolts and systems shall be set to the requirements of the plans and Contract. Anchor bolts and systems shall be clean and free of dirt, moisture or other foreign materials at the time of installation. The anchor bolts and systems shall be installed prior to placing concrete.

With the Engineer's approval, the Contractor may install anchorages after placement and setting of the concrete or in formed holes. The anchorages shall be installed into drilled or formed holes having a diameter and a depth suitable to receive the bolts in accordance with the grout manufacturer's requirements. Such holes shall be located to avoid damage to the

existing reinforcement. All holes shall be perpendicular to the plane surface. The Contractor shall take every precaution necessary to prevent damage to the concrete due to freezing of water or grout in anchor bolt holes.

- (l) **Ornament or Reverse Moulds:** Ornamental work, when so noted on the plans, shall be formed by the use of reverse moulds. These moulds shall be produced by a qualified manufacturer approved by the Engineer. They shall be built in accordance with the general dimensions and appearance shown on the plans. The Contractor shall submit all detailed drawings, models, or carvings for review by the Engineer before the moulds are made.

The Contractor shall be responsible for their condition at all times, and shall be required to remove and replace any damaged or defective moulds at no additional cost to the State.

The surfaces of the moulds shall be given a coating of form release agent to prevent the adherence of concrete. Any material which will adhere to or discolor the concrete shall not be used.

Form Liners, if required, shall be installed as specified elsewhere.

- (m) **Removal of Falsework and Forms:** The Contractor shall consider the location and character of the structure, the weather, the materials used in the mix, and other conditions influencing the early strength of the concrete when removing forms and falsework.

Methods of removal likely to cause damage to the concrete surface shall not be used.

Supports shall be removed in such a manner as to permit the structure to uniformly and gradually take the stresses due to its own weight. For structures of 2 or more spans, the sequence of falsework release shall be as specified in the Contract or approved by the Engineer.

Removal shall be controlled by field-cured cylinder tests. The removal shall not begin until the concrete has achieved 75% of the design compressive strength. To facilitate finishing, side forms carrying no load may be removed after 24 hours with the permission of the Engineer, but the curing process must be continued for 7 days.

When the results of field-cured cylinder tests are unavailable, the time periods listed in Table 6.01.03-1, exclusive of days when the temperature drops below 40°F, may govern the removal of forms.

Table 6.01.03-1 Time Restrictions for Removal of Formwork

Structure Element	Minimum Time Period
Arch Centers, centering under beams, pier caps, and unsupported elements	14 days
Slabs on grade, Abutments and Walls	24 hours
Columns	2 days
Bridge Decks	28 days

The Contractor may submit for review and approval by the Engineer, alternate methods to determine the in-place strength of the concrete for removal of forms and falsework.

- 2. Protection from Environmental Conditions:** The concrete shall be protected from damage due to weather or other environmental conditions during placing and curing periods. In-place concrete that has been damaged by weather conditions shall be either repaired to an acceptable condition or removed and replaced as determined by the Engineer.

- (a) **Rain Protection:** The placement of concrete shall not commence or continue unless

adequate protection satisfactory to the Engineer is provided by the Contractor.

(b) Hot Weather Protection: When the ambient air temperature is above 90°F, the forms, which will come in contact with the mix shall be cooled to below 90°F for a minimum of 1 hour prior to and 1 hour after completion of the concrete placement by means of a water spray or other methods satisfactory to the Engineer.

(c) Cold Weather Protection: When there is a probability of ambient air temperature below 40°F during placement and curing, a Cold-Weather Concreting Plan shall be submitted to the Engineer for review and comment. The Plan shall detail the methods and equipment, including temperature measuring devices that will be used to ensure that the required concrete and air temperatures are maintained.

1. Placement: The forms, reinforcing steel, steel beam flanges, and other surfaces which will come in contact with the mix shall be heated to a minimum of 40°F, by methods satisfactory to the Engineer, for a minimum of 1 hour prior to, and maintained throughout, concrete placement.
2. Curing: For the first 6 days, considered the initial cure period, the concrete shall be maintained at a temperature of not less than 45°F and the air temperature surrounding the structure shall be maintained at a temperature of not less than 60°F. When the concrete mix includes pozzolans or slag, the initial cure period shall be increased to 10 days. After the initial cure period, the air surrounding the structure shall be maintained above 40°F for an additional 8 days. If external heating is employed, the heat shall be applied and withdrawn gradually and uniformly so that no part of the concrete surface is heated to more than 90°F or caused to change temperature by more than 20°F in 8 hours. The Engineer may reduce or increase the amount of time that the structure must be protected or heated based on an indication of in-place concrete strength acceptable to the Engineer.

(d) Additional Requirements for Bridge Decks: Prior to the application of curing materials, all the concrete placed on bridge decks shall be protected from damage due to rapid evaporation by methods acceptable to the Engineer. During periods of low humidity (less than 60% relative humidity), sustained winds of 25 mph or more, or ambient air temperatures greater than 80°F the Contractor shall provide written details of additional measures to be taken during placement and curing.

Protection may include increasing the humidity of the surrounding air with fog sprayers and employing wind-breaks or sun-shades. Additional actions may include reduction of the temperature of the concrete prior to placement, scheduling placement during the cooler times of days or nights, or any combination of these actions.

(e) Concrete Exposed to Salt Water: No Construction joints shall be formed between the levels of extreme low water and extreme high water or the upper limit of wave action as determined by the Engineer.

3. Transportation and Delivery of Concrete: All material delivered to the Project shall be supplied by a producer qualified in accordance with M.03. The producer shall have sufficient plant capacity and trucks to ensure continuous delivery at the rate required to prevent the formation of cold joints.

(a) Material Documentation: All vendors producing concrete must have their weigh scales and mixing plant automated to provide a detailed ticket. Delivery tickets must include the following information:

1. State of Connecticut printed on ticket
2. Name of producer, identification of plant
3. Date and time of day
4. Type of material
5. Cubic yards of material loaded into truck
6. Project number, purchase order number, name of Contractor (if Contractor other than producer)
7. Truck number for specific identification of truck
8. Individual aggregate, cement, water weights and any admixtures shall be printed on plant tickets
9. Water/cement ratio, and
10. Additional water allowance in gallons based on water/cement ratio for mix

A State inspector may be present to monitor batching or weighing operations.

The Contractor shall notify the Engineer immediately if, during the production day, there is a malfunction of the recording system in the automated plant or weigh scales.

Manually written tickets containing all required information may be allowed for up to 1 hour after malfunction provided they are signed by an authorized representative of the producer.

- (b) Transportation of Mixture:** Trucks delivering concrete shall be qualified in accordance with M.03.

If the concrete mix arrives at the Project with a slump lower than allowed by specification, water may be considered as a means to temper concrete to bring the slump back to within specification. This tempering may only be done prior to discharge with the permission of the Engineer. The quantity of water in gallons added to the concrete cannot exceed the allowance shown on the delivery ticket.

The concrete shall be completely discharged into the forms within 1-1/2 hours from the batch time stamped on the delivery ticket. This time may be extended if the measured temperature of the concrete is below 90°F. This time may also be reduced if the temperature of the concrete is over 90° F. Rejected concrete shall be disposed of by the Contractor at no cost to the State.

The addition of chemical admixtures or air entrainment admixtures at the Project Site, to increase the workability or to alter the time of set, will only be permitted if prior approval has been granted by the Engineer. The addition of air entrainment admixtures at the Project Site will only be permitted by the producer's quality control staff. The Contractor is responsible for follow-up quality control testing to verify compliance with the Specifications.

4. Acceptance Testing and Test Specimens: The Contractor shall furnish the facilities and concrete required for sampling, transport to the testing location in the field, performing field testing and for casting sample cylinders for compressive-strength determinations. The Department will furnish personnel for sampling and casting Acceptance specimens and the number of specimens required will be determined by the Engineer. The equipment for the Department's testing is provided for elsewhere in the Contract.

- (a) Temperature, Air Content and Slump:** Field testing in accordance with AASHTO T-23, "Making and Curing Concrete Test Specimens in the Field" will be performed at the point of placement and at a frequency determined by the Engineer.

- (b) Acceptance Testing and Compressive Strength Specimens:** Concrete samples are to be taken at the point of placement into the forms or molds. Representatives of the Engineer will sample the mix.

Table 6.01.03-2 Plastic Properties of Portland Cement Concrete

Standard Mix Class	Air Content	Slump ³	Concrete Temperature
PCC0334Z ¹ (3300 psi)	6.0 +/- 1.5%	As submitted	60°-90° F
PCC0336Z ¹ (3300 psi)			
PCC0446Z ¹ (4400 psi)			
PCCXXX8Z ¹	7.5 +/- 1.5%	As submitted	
Modified Standards ²	6.0 +/- 1.5% ²	As submitted	
Special Provision Mix ⁴	As specified	As submitted	
¹ "Z" denotes the Exposure Factor 0, 1 or 2 as described in Table M.03.02-1a			
² Modifications to Standard Mixes, including mixes placed by pumping, shall be reviewed by the Engineer prior to use. These include but are not limited to the use of chemical admixtures such as high range water reducing (HRWR) admixtures and the use of coarse aggregate sizes for that class not specified in M.03.			
³ If the <u>only</u> modification is the addition of HRWR, the maximum allowable slump shall be 7 inches.			
⁴ All concrete mixes with a mix design strength not shown in the table must be approved by the Engineer on a case-by-case basis. Limits on the plastic properties and strength requirements of these mixes are listed in the Specifications.			

The Contractor shall provide and maintain facilities on the Project Site, acceptable to the Engineer, for sampling, transporting the initial sample, casting, safe storage and initial curing of the concrete test specimens as required by AASHTO T-23. This shall include but not be limited to a sampling receptacle, a means of transport of the initial concrete sample from the location of the concrete placement to the testing location, a level and protected area of adequate size to perform testing, and a specimen storage container capable of maintaining the temperature and moisture requirements for initial curing of Acceptance specimens. The distance from the location of concrete placement to the location of testing and initial curing shall be 100 feet or less, unless otherwise approved by the Engineer.

The specimen storage container described in this section is in addition to the concrete cylinder curing box provided for elsewhere in the Contract.

After initial curing, the test specimens will be transported by Department personnel and stored in the concrete cylinder curing box until they can be transported to the Division of Materials Testing for strength evaluation.

- (c) Sampling Procedure for Pumping:** It is the responsibility of the Contractor to provide concrete that meets specification at the point of placement.

Samples of concrete shall be taken at the discharge end of the pump at the point of placement with the exception of underwater concrete. The Contractor may submit an alternate location to provide a sample from the discharge end of the pump with verification showing that the characteristics of the mix will not be altered from that of which would have been attained at the point of placement. The Engineer will review the documentation and other extenuating circumstances when evaluating the request.

In the case of underwater concrete the Contractor shall submit the proposed sampling location with the submittals required in 6.01.03-II-6(f).

(d) Additional field testing: Additional field testing such as density and yield measurements may be required at the time of placement as determined by the Engineer.

5. Progression Cylinders and Compressive Strength Specimens: Progression Cylinders outlined in this section are field cured compressive strength specimens taken for information related to when a structure or segment of a structure can be loaded or put into service, adequacy of curing and protection of concrete in the structure, or when formwork or shoring may be removed from the structure. The information produced from strength results of Progression Cylinders will not be considered for acceptance of the concrete.

The personnel, equipment, and molds for sampling, casting, curing and testing of Progression Cylinders shall be furnished by the Contractor at no expense to the Department.

Sampling, casting, and field curing of the specimens shall be performed in accordance with AASHTO T23 by an ACI Concrete Field Testing Technician Grade 1 or higher and will be witnessed by a representative of the Department.

The sample shall be taken at the point of placement into the forms or molds from 1 or more of the same truck loads that an Acceptance sample is taken from.

A minimum of 2 of cylinder results will be used to determine in-place strength.

Compression testing shall be performed in accordance with AASHTO T 22 by personnel approved by the Engineer.

A Certified Test Report in accordance with 1.06.07 shall be provided to the Engineer reporting the Progression Cylinder test results. A copy of the results of the compressive strength testing shall be provided to the Engineer at least 24 hours prior to any Project activity that the results may control.

6. Handling and Placing Concrete: Concrete shall be handled, placed, and consolidated by methods acceptable to the Engineer that will not segregate the mix and shall result in a dense homogeneous concrete. The methods used shall not cause displacement of reinforcing steel or other materials to be embedded in the concrete. Concrete shall not be placed until the forms and all materials have been inspected by the Engineer. All mortar from previous placements, debris, and foreign material shall be removed from the forms and steel prior to commencing placement. The forms and subgrade shall be thoroughly moistened with water immediately before concrete is placed. All water that has ponded within the forms shall also be removed. Temporary form spreader devices shall not be left in place.

All laitance or unsound material shall be removed before placing substructure concrete onto the surface of any concrete placed underwater.

Placement of concrete for each section of the structure shall be performed continuously between construction or expansion joints as shown on the plans. The delivery rate, placing sequence and methods shall be such that fresh concrete is always placed and consolidated against previously placed concrete before initial set has occurred. The temperature of the concrete mixture during placement shall be maintained between 60°F and 90°F. During and after placement of concrete, care shall be taken not to damage the concrete or break the bond with reinforcing steel. Platforms for workers and equipment shall not be supported directly on any reinforcing steel. Forces that may damage the concrete shall not be applied to the forms or reinforcing steel.

- (a) Sequence of Placement:** The sequence of placement shall be in accordance with the Contract or as permitted by the Engineer.

Concrete for integral horizontal members, such as caps, slabs, or footings shall not be placed until the concrete for the columns, substructure, culvert walls and similar vertical members has achieved sufficient strength as stated in 6.01.03-II-1(m).

The concrete in arches shall be placed in such a manner as to load the formwork uniformly and symmetrically.

The base slab or footings of cast-in-place box culverts shall reach sufficient strength before the remainder of the culvert is constructed.

- (b) Placement Methods:** The Contractor shall notify the Engineer at least 24 hours in advance of intention to place concrete.

Vibrators shall not be used to shift the fresh concrete horizontally. Vibrators shall be adequate to consolidate the concrete and integrate it with the previous lift.

The rate of concrete placement must not produce loadings that exceed those considered in the design of the forms.

The use of chutes and pipes for conveying concrete into the forms must be reviewed by the Engineer. Chutes shall be clean, lined with smooth watertight material and, when steep slopes are involved, shall be equipped with baffles or reverses. When the discharge must be intermittent, a hopper or other device for regulating the discharge shall be provided.

Aluminum shall not be permanently incorporated into the concrete unless otherwise specified.

When placing operations involve dropping the concrete more than 5 feet, the Contractor shall take action to prevent segregation of the mix and spattering of mortar on steel and forms above the elevation of the lift being placed. This restriction shall not apply to cast-in-place pilings.

When using stay-in-place forms, concrete shall not be dropped more than 3 feet above the top of the forms, and the concrete shall be discharged directly over the beams or girders.

- (c) Pumping:** The Contractor shall use equipment specifically manufactured to pump concrete mixes and that meets the needs of the specific concrete placement.

- (d) Consolidation:** Unless otherwise specified, all concrete, except concrete placed under water, shall be sufficiently consolidated by mechanical vibration immediately after placement.

The Contractor shall provide a sufficient number of commercially available mechanical immersion type vibrators to properly consolidate the concrete immediately after it is placed in the forms unless external form vibrators are used. The Contractor shall have an adequate number of operable vibrators available in case of breakdown.

External form vibrators may be used if submitted prior to concrete placement and reviewed by the Engineer.

Vibration shall not be applied directly to the reinforcement or hardened concrete. Special care shall be taken in placing and consolidating concrete around ornamental moulds, form liners and other embedded items. The vibrator shall not touch these items at any time.

- (e) Additional Requirements for Bridge Decks:** At least 15 days before the erection of the screed rails, the Contractor shall submit screed erection plans, grades and sequence of concrete placement and proposed rate of placing concrete for review by the Engineer.

These plans shall include details of equipment to be used in the placement and finishing of the concrete, including the number and type of personnel who will be engaged in placing the concrete. The screed equipment shall be a commercially available vibratory system. The use of wooden screeds is prohibited.

When setting screed rails for mechanical finishing, the Contractor shall take into consideration and make proper allowances for the deflection of the bridge superstructure due to all operations.

Screed and runway supports shall not be located on any stay-in-place metal form sheets, form supports or reinforcing steel. The Contractor shall operate the mechanical screed at least 24 hours prior to actual placement of the concrete to verify deck survey and equipment operations to the satisfaction of the Engineer.

A Pre-Placement Meeting shall be held on the project site with Contractor, Engineer and concrete supplier 48 hours before the concrete deck pour. The Pre-Placement Meeting will document and include discussion on the following topics:

1. Schedule:

- (a) Deck pour sequence
- (b) Daily start and finish times for concrete delivery
- (c) Anticipated completion time

2. Key Personnel:

- (a) Concrete placement foreman
- (b) Total number of personnel involved in deck pour and their roles during the pour
- (c) Concrete supplier
- (d) Concrete pump truck operator/service
- (e) Discuss QC/QA

3. Placement:

- (a) List of approved delivery trucks per pour
- (b) Pre-wetting forms prior to placement
- (c) Placement sequence
- (d) Rate of concrete placement and vibrator process
- (e) Monitor concrete temperature during placement
- (f) Transverse joint bulkheads
- (g) Approved concrete low-permeability mix design

4. Curing:

- (a) Curing materials (burlap, quilted blankets, etc.)
- (b) Means for pre-soaking curing materials.
- (c) Foggers
- (d) Soaker hoses
- (e) White Plastic Sheeting
- (f) Water source and supply tanks

Concrete shall be deposited in a uniform manner across the entire width being placed, and only 2 passes of the transverse screed will be permitted over a given deck area, unless otherwise allowed by the Engineer.

If the Contractor proposes to place concrete outside of daylight hours, an adequate lighting system must be provided.

Concrete shall be deposited in accordance with the placement sequence as noted on the plans. If no sequence is indicated, the Contractor shall provide a placement sequence to the Engineer for review. The placement sequence shall proceed in such a manner that the total deflection or settlement of supporting members, and the final finishing of the surface will occur before the initial set of the concrete takes place.

At construction joints, concrete shall not be placed against the previously placed concrete for at least 12 hours unless otherwise allowed by the Engineer.

- (f) Underwater Placement:** Concrete may only be placed under water within a cofferdam unless otherwise specified in the Contract or allowed by the Engineer. Placement shall begin following inspection and acceptance of the depth and character of the foundation material by the Engineer.

Underwater concrete mixes are considered non-standard designs and shall be submitted to the Engineer for approval. Typically a minimum of 10% additional cement than comparable non-underwater mixes will be required.

Underwater concrete shall be placed continuously with the surface of the concrete kept as horizontal as practical. To ensure thorough bonding, each succeeding layer shall be placed before the preceding layer has taken initial set. For large concrete placements, more than 1 tremie or pump shall be used to ensure compliance with this requirement.

Mass concrete placement requirements, outlined in 6.01.03-II-6(g), do not apply to underwater concrete.

To prevent segregation, underwater concrete shall be placed in a compact mass, in its final position, by means of a tremie, concrete pump, or other approved method and shall not be disturbed. Still water shall be maintained at the point of deposit. Cofferdams shall be vented during the placement and curing of the concrete to equalize the hydrostatic pressure and thus prevent flow of water through the concrete.

If a tremie is used, the method of depositing the concrete shall be detailed in a submission to the Engineer as a working drawing for review. The tube shall have watertight couplings and shall permit the free movement of the discharge end over the area of the work.

- (g) Mass concrete placement:** Mass concrete placement shall be defined as any placement, excluding underwater concrete placement, in which the concrete being cast has dimensions of 5 feet or greater in each of 3 different directions. For placements with a circular cross-section, a mass concrete placement shall be defined as any placement that has a diameter of 6 feet or greater and a height of 5 feet or greater. For all mass concrete placements, the mix temperature shall not exceed 85°F as measured at point of discharge into the forms.

Any special concrete mix design proposed by the Contractor to meet the above temperature requirements shall be submitted to the Engineer for review.

7. Finishing Plastic Concrete: Unless otherwise specified in the Contract, after concrete has been consolidated and prior to final curing, all surfaces of concrete that are not placed against forms shall be struck-off to the planned elevation or slope. The surface shall be finished by floating with an acceptable tool. While the concrete is still in a workable state, all construction and expansion joints shall be tooled with an edger. Joint filler shall be left exposed. For requirements on float finish, refer to 6.01.03-II-10, Finishing Concrete Surfaces.

After completion of the placing and finishing operation and for at least 12 hours after the concrete has set, the Contractor shall not operate any equipment in the immediate vicinity of the

freshly placed concrete if, in the opinion of the Engineer, it could cause excessive vibration, movement or deflection of the forms.

The addition of water to the surface of the concrete to assist in finishing operations will not be permitted.

(a) Bridge Decks: After the concrete has been consolidated and brought to the proper elevation by the screed machine, it shall be finished by use of a suitable float. The Contractor shall not disturb the fresh concrete after it has been finished. All finishing work, including the application of the fog spray and placement of the curing mats, shall be performed from work bridges supported above the deck surface. A work bridge shall be made available to the Engineer for inspection of the concrete work.

Surfaces that are to be covered with a waterproofing membrane shall be finished to a smooth surface, free of mortar ridges and other projections and in accordance with the membrane manufacturer's recommendations.

Unless otherwise noted in the Contract, the concrete wearing surfaces shall be given a skid-resistant texture by dragging, brooming, tining, or by a combination of these methods. These methods shall be done after floating and at such time and in such manner that the desired texture will be achieved while minimizing displacement of the larger aggregate particles.

1. Dragging: The surface shall be finished by dragging a seamless strip of damp burlap over the surface. The burlap to be dragged shall consist of sufficient layers and have sufficient length in contact with the concrete to slightly groove the surface. The burlap shall be drawn longitudinally along the surface in a slow manner so as to leave an even texture. The burlap shall be kept damp, clean, and free of particles of hardened concrete. The Contractor may propose an alternate material for the Engineer's consideration.
2. Tining: Tining shall be in a transverse direction using a wire broom, comb, or float having a single row of tines or fins. The tining grooves shall be between 1/16 inch and 3/16 inch wide and between 1/8 inch and 3/16 inch deep, spaced 1/2 inch to 3/4 inch on centers. Tining shall be discontinued 12 inches from the curb line on bridge decks. The area adjacent to the curbs shall be given a light broom finish longitudinally. As an alternative, tining may be achieved using a machine designed specifically for tining or grooving concrete pavements.

The transverse grooving shall be performed when the grooves can be formed to a maximum depth of 3/16 inch with relative ease and without the walls of the grooves closing in on each other. The tining shall be aligned so as to prevent overlapping of grooves in any 2 successive transverse passes. The Contractor shall measure the depth of the grooves in the presence of the Engineer with an appropriate device to ensure compliance.

(b) Surface Testing and Correction: The completed surface shall be constructed in accordance with grades and cross slopes shown on the plans. The entire surface shall be checked by the Contractor in the presence of the Engineer, with an acceptable 10 foot straightedge.

1. The surface shall not vary more than +/- 1/8 inch over 10 feet for decks which will not be covered with an overlay.
2. The surface shall not vary more than +/- 1/4 inch over 10 feet for decks which will be

covered with an overlay.

Variations greater than these, which, in the opinion of the Engineer, may adversely affect the riding qualities of the surface shall be corrected, and this shall be done at the expense of the Contractor. The Contractor shall submit a corrective procedure to the Engineer for review and approval. The procedure shall correct such irregularities by methods such as, but not limited to, concrete planing or grooving.

8. Bearing Surfaces: Concrete surfaces under metallic masonry plates and elastomeric bearings shall have a float finish. After the concrete has set, the area which will be in contact with the masonry plate shall be ground as necessary to provide full and even bearing. The finished surface shall not vary from a straightedge laid on the surface in any direction within the limits of the masonry plate by more than 0.0625 inch. Surfaces which fail to conform shall be ground or filled until acceptable to the Engineer.

9. Curing Concrete: All newly placed concrete shall be cured so as to prevent loss of water by use of the methods specified. The Engineer may request that the Contractor furnish a curing plan.

The duration of the initial and final curing period in total shall continue uninterrupted for a minimum of 7 days.

(a) Curing Methods:

1. Forms-In-Place Method: Formed surfaces of concrete may be cured by retaining the forms in place without loosening. During periods of hot weather, water shall be applied to the forms until the Engineer determines that it is no longer required.
2. Water Method: Exposed concrete surfaces shall be kept continuously wet by ponding, spraying, or covering with materials that are kept continuously and thoroughly wet. Such materials may consist of cotton mats, multiple layers of burlap, or other approved materials that do not discolor or otherwise damage the concrete.
3. Waterproof Cover Method: This method shall consist of covering exposed surfaces with a waterproof sheet material to prevent moisture loss from the concrete. The concrete shall be wet at the time the cover is installed. The sheets shall be of the widest practicable width and adjacent sheets shall overlap a minimum of 6.0 inches to form a waterproof cover of the entire concrete surface and shall be adequately secured. Broken or damaged sheets shall be immediately repaired and the concrete shall be remoistened.

(b) Additional Requirements for Bridge Decks:

Curing Plan: The Contractor shall submit to the Engineer, at least 14 days prior to the placement of concrete for the bridge deck, a detailed curing plan that describes the following:

- A. the initial and final curing durations,
- B. equipment and materials to be used for curing concrete and monitoring concrete temperature,
- C. and proposed primary and secondary water and heat sources
 1. Initial Curing Period: A water fog spray shall be used by the Contractor from the time of initial placement until the final curing period begins. The amount of fog spray shall be strictly controlled so that accumulations of standing or flowing water on the surface of the concrete shall not occur.

Should atmospheric conditions render the use of fog spray impractical, the Contractor shall request approval from the Engineer to use a curing compound that meets the requirements of M.03 in lieu of a fog spray. The application shall be in accordance with the manufacturer's recommendation and be compatible with the membrane waterproofing.

2. Final Curing: After completion of finishing and as soon as any bleed water has dissipated and the concrete reaches sufficient strength to avoid marring, the Final curing period shall begin and the entire concrete surface shall be covered with water-retaining materials such as cotton mats, multiple layers of burlap, or other materials approved by the Engineer. Materials used shall be kept saturated by means of an acceptable sprinkler or wetting system.

The Contractor may cover the wet water-retaining material with a suitable polyethylene film to minimize evaporation during the curing period. The use of the polyethylene film does not relieve the Contractor from maintaining saturation of the curing materials.

3. Temperature Monitoring: The internal temperature of the concrete shall be monitored with a calibrated continuous recording thermometer for a minimum of 7 days. The air temperature at the concrete surface or the air temperature between the concrete surface and its protective covering shall be monitored with a minimum of 1 recording thermometer.

The number and placement of the thermometers will be determined by the Engineer. A minimum of 2 thermometers per concrete placement shall be provided by the Contractor.

The following types of thermometers shall be used to monitor curing temperatures:

- i) Continuously Recording Thermometer: The thermometer shall be capable of continuously recording temperatures within a range of -4°F to 122°F for a minimum of 24 hours.
- ii) Maximum–Minimum Recording Thermometer: For all placements, the thermometer shall be capable of recording maximum and minimum temperatures in a range of -4°F to 122°F.

10. Finishing Concrete Surfaces: Any minor repairs due to fins, bulges, offsets and irregular projections shall be performed immediately following the removal of forms. For areas of newly placed concrete that are honeycombed or segregated the Contractor shall provide a written corrective procedure for review by the Engineer prior to the work being performed. Construction and expansion joints in the completed work shall be left carefully tooled and free of mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

The cavities produced by form ties and all other holes, broken corners or edges, and other defects shall be cleaned, saturated with water, pointed and trued with a mortar conforming to M.11.04. Cement similar in color to the exposed surface being repaired shall be added to the mortar. Mortar used in pointing shall be used within 1 hour of mixing. The concrete shall be finished as defined below if required and the cure continued as previously specified in 6.01.03-II-9, Curing Concrete.

Finishing work shall not interrupt the curing period unless permitted by the Engineer. The curing period may be extended to provide the minimum total number of days required.

Concrete surface finishes shall be classified as follows:

- (a) **Float Finish:** This finish shall be achieved by placing an excess of material in the form and removing or striking off of such excess forcing the coarse aggregate below the mortar surface. Concave surfaces in which water will be retained will not be allowed. After the concrete has been struck off, the surface shall be thoroughly worked and floated. Before this last finish has set, the surface shall be lightly stripped with a fine brush to remove the surface cement film, leaving a fine-grained, smooth, but sanded texture. Curing, as specified elsewhere, shall follow. Any surfaces that will support appurtenances such as light standards, railing, or fences shall be finished in accordance with 6.01.03-II-8, Bearing Surfaces.
- (b) **Rubbed Finish:** The initial rubbing shall only be allowed within 3 days after placement. The entire surface shall be thoroughly wet with a brush and rubbed with a No. 16 Carborundum Stone or an abrasive of equal quality, bringing the surface to a paste. The rubbing shall be continued sufficiently to remove all form marks and projections, producing a smooth, dense surface without pits or irregularities. The paste formed by the rubbing may be finished by stripping with a clean brush, or it may be spread uniformly over the surface and allowed to re-set. If all or portions of the rubbed surface are unacceptable to the Engineer or a rubbed finish is not provided within 3 days after removal of forms, the Contractor will be directed to provide a grout clean down finish.
- (c) **Grout Clean-Down Finish:** As soon as all cavities have been filled as required elsewhere and the cement mortar has set sufficiently, grout clean-down shall be performed. All burrs, unevenness, laitance, including that in air holes, and any other material which will adversely affect the bond of the grout to the concrete, shall be removed by acceptable methods. This cleaning shall be done from the top or uppermost part of the surface to be finished to the bottom.

A mixture of a fine aggregate and Portland cement shall be thoroughly blended while dry. The proportions shall be such that when mixed with the proper amount of water, the color will match that of the concrete to be finished. Water shall be added to this mixture in an amount which will bring the grout to a workable thick paint-like consistency.

The surface to be treated shall be thoroughly wetted with a sufficient amount of water to prevent the absorption of water from the grout. Grout shall then be applied to the wetted surface before setting of the grout occurs. Grout which has set shall not be re-tempered and shall be disposed of by the Contractor at no cost to the State.

The grout shall be uniformly applied over the entire surface, completely filling all air bubbles and holes. Immediately after applying the grout, the surface shall be floated with a suitable float, scouring the surface vigorously. While the grout is still plastic, all excess grout shall be removed.

After the final rubbing is completed and the surface has dried, it shall be rubbed to remove loose powder and shall be left free from all unsound patches, paste, powder, and objectionable marks. Wetting, application and removal of excess grout shall be completed in 1 work shift.

All finished surfaces shall be cured for a minimum of 24 hours. Horizontal surfaces shall have a float finish and vertical exposed surfaces shall have a rubbed finish. A grout clean down finish may be substituted for a rubbed finish as noted in this section or as directed by the Engineer.

11. Mortar, Grout, Epoxy and Joint Seal:

- (a) **Mortar and Grout:** This work consists of the making and placing of mortar and grout. At least 48 hours prior to the planned use, a copy of the installation instructions and MSDS sheets shall be provided to the Engineer for review and concurrence of their applicability and for verification of proper hole sizes in concrete structures. Such uses include mortar for filling under masonry plates, mortar used to fill voids and repair surface defects, grout used to fill sleeves for anchor bolts, and mortar and grout for other such uses where required or approved.

Concrete areas to be in contact with the mortar or grout shall be cleaned of all loose or foreign material that would in any way prevent bond, and the concrete surfaces shall be flushed with water and allowed to dry until no free-standing water is present.

The mortar or grout shall completely fill and shall be tightly packed into recesses and holes, on surfaces, under structural members, and at other locations specified. After placing, all surfaces of mortar or grout shall be cured as previously specified in 6.01.03-II-9(a)-2, for a period of not less than 3 days.

- (b) **Epoxy:** The epoxy shall be prepared and placed in accordance with the manufacturer's directions and with the equipment prescribed by the manufacturer. Instructions furnished by the supplier for the safe storage, mixing, handling and application of the epoxy shall be followed. Contents of damaged or previously opened containers shall not be used.

- (c) **Joint Seal:** This work consists of sealing joints where shown on the plans or as otherwise directed by the Engineer.

Before placement of the sealing material, the joints shall be thoroughly cleaned of all scale, loose concrete, dirt, dust or other foreign matter. Projections of concrete into the joint space shall be removed. The joint shall be clean and dry before the sealing compound is applied.

The joint sealant shall be prepared and placed in accordance with the manufacturer's directions and with the equipment prescribed by the manufacturer. The sealing compound shall be flush with, or not more than 1/8 inch above the adjacent surface of concrete, cutting off all excess compounds after the application. The joints shall be sealed in a neat and workmanlike manner and when the work is completed, the joints shall effectively seal against infiltration of moisture and water.

The Contractor shall arrange for, and have present at the commencement of the joint-sealing operation, a technically competent manufacturer's representative knowledgeable in the methods of installation of the sealant. The Contractor shall also arrange to have the representative present at such other times as the Engineer may request.

- (d) **Closed Cell Elastomer:** The closed cell elastomer shall be of the thickness specified and installed as shown on the plans and shall be in accordance with M.03.08-6.

12. Application of Loads: Loads shall not be applied to concrete structures until the concrete has attained sufficient strength and, when applicable, sufficient pre-stressing and post tensioning has been completed, so that damage will not occur. The means to determine when the concrete has attained sufficient strength shall be the use of Progression cylinders as defined elsewhere in this specification, or other means approved in advance by the Engineer.

- (a) **Earth Loads:** The placement of backfill shall not begin until the concrete is cured and has reached at least 80% of its specified strength unless otherwise permitted by the Engineer.

The sequence of placing backfill around structures shall minimize overturning or sliding forces and flexural stresses in the concrete.

- (b) Construction Loads:** Light materials and equipment may be hand carried onto bridge decks only after the concrete has been in place at least 24 hours providing curing is not interfered with and the surface texture is not damaged.

Prior to the concrete achieving its specified compressive strength, any other live or dead loads imposed on existing, new, or partially completed portions of structures, shall not exceed the reduced load carrying capacity of the structure, or portion of structure. The Contractor may be required to submit calculations to the Engineer that verify these requirements are being met. The compressive strength of concrete ($f'c$) to be used in computing the load-carrying capacity shall be the smaller of the actual field compressive strength at the time of loading or the specified design strength of the concrete. The means to determine the actual field compressive strength shall be approved by the Engineer.

For post-tensioned structures, no live or dead loads shall be allowed on any span until the steel for that span has been tensioned.

- (c)** Precast concrete or steel girders shall not be placed on substructure elements until the substructure concrete has attained 85% of its specified strength.

No load shall be allowed on mortar or grout that has been in place less than 72 hours.

- (d) Traffic Loads:** The concrete deck will not be opened to traffic until at least 14 days after the last placement of deck concrete and until such concrete has attained its specified strength.

13. Dispute Resolution: The basis of any dispute resolution is side-by-side and quality control testing by the Contractor or the Contractor's representative. The Contractor and Engineer should perform independent testing on the material to reasonably establish the true characteristics of the material at the time of delivery. Absent of Contractor QC testing, the Engineer's test results will apply to the quantity of concrete represented by the sample, not to exceed 75 c.y.

Air Content: Contractor QC Testing must be performed by personnel qualified by The American Concrete Institute as an ACI Concrete Field Testing Technician Grade 1 or higher and performed in accordance with AASHTO T-23. If the Contractor's test results vary from those of the Engineer, the Contractor shall immediately notify the Engineer of the difference and work cooperatively to determine the reasonable cause and recognize the valid test. Should there be agreement, the result of the valid test will be used for acceptance and adjustment purposes for that lot of material. Should there not be an agreement as to the valid test, an additional set of tests should be performed. Results of all valid tests on the same lot may be averaged and used for acceptance and adjustment purposes. Should the Contractor wish to perform additional QC testing on subsequent material, the lot sizes may be adjusted to the amount of material included in that specific delivery. Any such QC testing must be witnessed and agreed to by the Engineer.

Compressive Strength: Contractor QC testing for compressive strength must be performed in accordance with AASHTO T-22 by personnel approved by the Engineer. Samples used to dispute the Engineer's test results must be made simultaneously and from the same batch of concrete. Should the Contractor wish to pursue a dispute resolution with regard to compressive strength, the Contractor shall submit in writing to the Engineer all test results, control charts, or other documentation that may be useful in determining if the specific lot(s) of material met the Contract specifications. The Engineer will consider the submittal and may average specific test results on the disputed lot(s) for acceptance and adjustment purposes. Destructive testing of any

kind on the placed concrete structure will not be allowed.

III. Additional Requirements for Surface Repairs and Structural Repairs

1. Work Area Access and Shielding: Prior to removal of existing concrete, the Contractor shall provide access to the anticipated work areas so that the inspector and the Contractor may together determine and delineate the exact limits and locations of the work.

The Contractor shall design, furnish, install and remove a shield(s) to prevent debris from entering areas adjacent or beneath the work. The Contractor shall submit working drawings to the Engineer in accordance with 1.05.02. The shield(s) shall be maintained by the Contractor and remain in place during all phases of the repair work.

2. Concrete Removal: The perimeter of each area to be repaired shall be saw cut as shown on the plans. All concrete within that area shall be removed to at least 1 inch beneath any visible reinforcing steel and to sound concrete. The reinforcing steel shall not be damaged or its bond in the surrounding concrete. The Contractor must use fifteen (15) pound hammers or other methods accepted by the Engineer.

In addition to removal of concrete to a depth of 1 inch below reinforcing steel, localized areas of removal may be required if embedded galvanic anodes are specified in the Contract, to allow a minimum of 2 inches of concrete cover over the anodes.

Any steel reinforcing scheduled to be left in place that is damaged during the concrete removal process shall be replaced in accordance with 6.02 to the satisfaction of the Engineer and at the expense of the Contractor.

Corroded, missing, or broken reinforcing steel shall be replaced in accordance with 6.02 and as shown on the plans or as directed by the Engineer.

The Contractor shall perform the work in a manner that prevents debris from entering roadway lanes or areas below the structure. All debris shall be removed from the Site and disposed of by the Contractor.

3. Surface Preparation: All newly exposed surfaces of concrete shall be sandblasted and be visibly free from oil, solvent, grease, loose particles, or any other foreign matter. Exposed reinforcing steel shall be sandblasted in accordance with SSPC-SP-6, Commercial Blast Cleaning, to remove all contaminants, rust and rust scale.

4. Installation of Embedded Galvanic Anodes: After sandblasting reinforcing steel, galvanic anodes shall be embedded where shown on the plans and in accordance with the Contract.

5. Welded Wire Fabric in Vertical and Overhead Surface Repairs: Prior to installing formwork, steel welded wire fabric meeting the requirements of M.06.01-3 shall be installed at the proper depth in those areas as shown on the plans or directed by the Engineer. The fabric shall be tied to exposed reinforcing steel or anchored to sound concrete using means approved by the Engineer.

6. Formwork: Forms and support systems shall be designed in accordance with 6.01.03-II-1. Forms shall be so designed so that access is from the top of the formwork. If access is not possible from the top of the formwork, the Contractor shall submit a method of concrete placement for review by the Engineer.

7. Concrete Placement and Curing: Bonding compounds shall not be used before or during the placement of the concrete. Exposed surfaces shall be wetted with water immediately prior to placement. There shall be no excessive water on the surface or in the formwork. Light rust on sandblasted reinforcing steel can be anticipated and is acceptable.

The temperature of the air and surface to be repaired at the time of placement and curing shall be a minimum of 45°F. Concrete shall be placed and consolidated immediately with appropriate vibratory equipment.

Forms shall be kept moist and shall be left in place for a minimum of 7 days or as shown on the plans.

8. Form Removal and Sequence of Repair: Form removal shall be in accordance with 6.01.03-II-1(m) unless otherwise noted on the plans. The Contractor shall follow the sequence of repairs shown on the plans.

9. Finishing: Immediately following curing and form stripping, the exposed faces shall be finished in accordance with Subarticle 6.01.03-II-10(c) Grout Clean-Down Finish.

10. Sounding of Completed Repairs: Cured and finished areas may be sounded by the Engineer to detect the presence of subsurface voids or delamination. Such areas shall be removed and replaced by the Contractor at its expense until an acceptable repair is in place as determined by the Engineer.

11. Sealing Concrete Surfaces: After all repairs have been accepted, penetrating sealer shall be applied in accordance with the Contract to the repaired areas as well as all contiguous areas to the repair or as directed by the Engineer.

6.01.04—Method of Measurement: This work will be measured for payment as follows:

1. Concrete used for new construction: The quantity of concrete used for new construction will be the actual volume in cubic yards of the specified class, with the exception of underwater concrete, completed and accepted within the neat lines as shown on the plans or as ordered by the Engineer. Parapets will be measured for payment by the number of linear feet of parapet, completed and accepted. The length of parapet will be measured along the centerline of the top of the parapet.

When concrete is placed against bedrock, a maximum of 6 additional inches beyond the neat lines can be measured for payment.

No deduction will be made for panels, form liners, reinforcing bars, structural steel shapes or for pile heads. There will be no deduction made for the volume occupied by culvert and drainage pipes, scuppers, weep holes, public utility structures or any other opening, unless the surface area of any such single opening is 9 s.f. or more.

In the case of culverts or drainage pipes, the computation of the surface area will be based on the nominal diameter of the pipe, disregarding the thickness of the shell.

Miscellaneous materials necessary for completion of the work such as felt, mortar, grout, epoxy and joint seal will not be measured for payment.

Incidental work such as forming for anchor bolts, utilities, keyways, and sampling and testing will not be measured for payment.

The work to produce and administer the Concrete Quality Control Plan (CQCP) will not be measured for payment.

2. Underwater Concrete: When underwater concrete is used, it will be measured by the volume in cubic yards within the actual horizontal limits of the cofferdam and between the elevations established by the Engineer.

3. Concrete used for Surface or Structural Repairs: The quantity of concrete used for surface repairs or structural repairs will be the actual volume completed and accepted. Welded wire fabric used in repair areas will not be measured for payment.

4. Joint Filler: This material will be measured by the area in square feet of the joint filler, of the type and thickness specified, installed and accepted.

5. Closed Cell Elastomer: This material will be measured by the volume in cubic inches of elastomer, of the thickness specified, installed and accepted.

6.01.05—Basis of Payment: Payment for this work will be made as follows:

1. Concrete: Progress payments may be allowed for completed major labor elements of work such as forming, placing and curing. Prior to placement, the Contractor shall submit a proposed schedule of values for review and approval by the Engineer.

Payment for any lot of concrete allowed to remain in place will be adjusted when the field and laboratory testing of the material is completed. The quantity of concrete in each lot for new construction will be a maximum of 75 c.y. Payment for each lot of concrete will be adjusted based on the results of the acceptance testing performed by the Engineer.

The pay factors listed in Table 6.01.05-1 apply for Standard and Modified Standard Mix classes with regard to entrained air content.

Table 6.01.05-1 Entrained Air Content Pay Factors

Specified Entrained air (%)*				Pay factor (%)
6.0 +/- 1.5%		7.5 +/- 1.5%		1.00 (100)
4.3 and 4.4	7.6 and 7.7	5.8 and 5.9	9.1 and 9.2	0.98 (98)
4.1 and 4.2	7.8 and 7.9	5.6 and 5.7	9.3 and 9.4	0.96 (96)
3.9 and 4.0	8.0 and 8.1	5.4 and 5.5	9.5 and 9.6	0.94 (94)
3.7 and 3.8	8.2 and 8.3	5.2 and 5.3	9.7 and 9.8	0.92 (92)
3.5 and 3.6	8.4 and 8.5	5.0 and 5.1	9.9 and 10.0	0.90 (90)
Concrete lots with less than 3.5% or greater than 8.5% entrained air will be rejected.		Concrete lots with less than 5.0% or greater than 10% entrained air will be rejected.		
*Air content measured at time and point of placement				

The pay factors listed in Table 6.01.05-2a apply for Standard and Modified Standard Mix classes with regard to compressive strength.

Table 6.01.05-2a Compressive Strength Pay Factors

Compressive Strength (%)	Pay factor (%)
95 or greater	1.00 (100)
90 to 94.9	0.95 (95)
85 to 89.9	0.90 (90)
*Measured at 28 days	
Concrete lots with less than 85% specified strength will be rejected.	

The pay factors listed in Table 6.01.05-2b apply for Standard and Modified Standard Mix classes with regard to surface resistivity when specified in accordance with AASHTO T 358 using 4 inch × 8-inch cylinders.

Table 6.01.05-2b Permeability Pay Factors

Surface Resistivity (kΩ-cm)*	Pay factor (%)
29 or greater	1 (100)
25 to 28.9	0.85 (85)
21 to 24.9	0.75 (75)
*Measured at 56 days	
Concrete lots with resistivity values less than 21 will be rejected.	

The payment adjustment value for entrained air, 28-day strength, and permeability if applicable, for any lot of concrete for new construction that is allowed to remain in-place is determined using the formulas listed in Table 6.01.05-3a. An Index Price of \$400.00 per c.y. will be used to calculate each adjustment, except for Parapet Concrete, for which an Index Price of \$100 per l.f. will be used. The sum of the individual adjustment values will be deducted from the cubic yard or linear foot payment for the appropriate item.

Table 6.01.05-3a Payment Adjustment Formulas for New Construction

Adj (air) = (1 - air pay factor) × Index Price × lot size (c.y. or l.f.)
Adj (strength) = (1 - strength pay factor) × Index Price × lot size (c.y. or l.f.)
Adj (permeability) = (1 - permeability pay factor) × Index Price × lot size (c.y. or l.f.)
Total Adjustment = Adj (air) + Adj (strength) + Adj (permeability)

The payment adjustment value for entrained air and 28-day strength for any lot of repair concrete that is allowed to remain in-place is determined using the formulas listed in Table 6.01.05-3b. An index price of \$200.00 per c.f. shall be used to calculate each adjustment. The total adjustment value will be the sum of each individual adjustment value and will be deducted from the cubic foot payment for the appropriate item.

Table 6.01.05-3b Payment Adjustment Formulas for Repair Concrete

Adj (air) = (1 - air pay factor) × \$200/c.f. × lot size (c.f.)
Adj (strength) = (1 - strength pay factor) × \$200/c.f. × lot size (c.f.)
Total Adj = Adj (air) + Adj (strength)

The Contractor shall request permission from the Engineer to remove and replace a lot(s) of concrete to avoid a negative payment adjustment. Any replacement material will be sampled, tested and evaluated in accordance with this specification.

No direct payment will be made for any labor, equipment or materials used during the sampling and testing of the concrete for Progression or Acceptance. The cost shall be considered as included in the general cost of the work or as stated elsewhere in the Contract. The work of transporting the concrete test specimens, after initial curing, for Acceptance testing will be performed by the Department without expense to the Contractor.

This material used for new construction will be paid for at the Contract unit price per cubic yard or linear foot less any adjustments, for the specified class, complete in place, which price shall include all materials, equipment, tools, labor and work incidental thereto, including Concrete Quality Control Plan, heating, all admixtures, joint sealer, roofing felt, and any miscellaneous materials such as metal flashing and metal used in expansion joints and bearings.

2. Underwater Concrete: When this class of concrete is used, it will be paid for at the Contract unit price per cubic yard for "Underwater Concrete," complete in place, which price shall include all materials, equipment, tools, labor and work incidental thereto.

3. Concrete Used For Structural Repairs or Surface Repairs: The material used for structural repairs or surface repairs will be paid for at the Contract unit price per cubic foot less any adjustments, complete in place, which price shall include saw cutting, removing concrete, sandblasting, cleaning, forming, placing, curing, stripping, and finishing new surfaces, and all materials, equipment, tools, labor and clean-up incidental thereto.

4. Joint Filler: Expansion joint filler will be paid for at the Contract unit price per square foot for "Joint Filler for Bridges" of the type and thickness specified, complete in place, which price shall include all materials, equipment, tools, labor and work incidental thereto.

5. Closed Cell Elastomer: Closed cell elastomer will be paid for at the Contract unit price per cubic inch for "Closed Cell Elastomer" of the thickness specified, complete in place, which price shall include all materials, equipment, tools, labor and work incidental thereto.

Embedded galvanic anodes, deformed steel bars, and penetrating sealer, will be paid for separately.

Pay Item	Pay Unit
Footing Concrete	c.y.
Footing Concrete (Mass)	c.y.
Abutment and Wall Concrete	c.y.
Abutment and Wall Concrete (Mass)	c.y.
Column and Cap Concrete	c.y.
Column and Cap Concrete (Mass)	c.y.
Bridge Deck Concrete	c.y.
Bridge Deck Concrete (SIP Forms)	c.y.
Parapet Concrete	l.f.
Bridge Sidewalk Concrete	c.y.
Approach Slab Concrete	c.y.
Barrier Wall Concrete	c.y.
Underwater Concrete	c.y.
Surface Repair Concrete	c.f.
Structural Repair Concrete	c.f.
Class PCCXXYZ Concrete	c.y.
(Thickness and Type) Joint Filler for Bridges	s.f.
(Thickness) Closed Cell Elastomer	c.i.

SECTION M.03 - PORTLAND CEMENT CONCRETE

Replace Section M.03 in its entirety with the following:

M.03.01—Component Materials

M.03.02—Mix Design Requirements

M.03.03—Producer Equipment and Production Requirements

M.03.04—Curing Materials

M.03.05—Non Shrink, Non Staining Grout

M.03.06—Expansive Cement for Anchoring

M.03.07—Chemical Anchors

M.03.08—Joint Materials

M.03.09—Protective Compound/Sealers

M.03.10—Formwork

M.03.01—Component Materials

1. Coarse Aggregate: Coarse aggregate shall meet the requirements of M.01.

2. Fine Aggregate: Fine aggregate shall meet the requirements of M.01.

3. Cement:

(a) Portland: Types I, II, and III Portland cement shall meet the requirements of AASHTO M 85. Type I and Type III Portland cement shall be used only when required or expressly permitted by the Project specification or the Engineer. The use of Type I or III will require that these mixtures be submitted as Non-standard Mix Designs. All cement shall be provided by a mill participating in the Departments' Cement Certification program. The requirements of the Certification Program are detailed in the Departments' Quality Assurance Program for Materials.

(b) Pre-Blended Cements: Binary or Ternary cements consisting of Portland Cement and supplemental cementitious materials may be used provided that all the requirements of M.03.01- 3(a) and -3(c) are met.

(c) Replacement Materials: Unless already approved as a Standard Mix Design, any Contractor proposed Mix Designs with partial replacement of Portland Cement (PC) with fly ash or ground granulated blast furnace slag (GGBFS), shall be submitted in writing to the Engineer for approval prior to the start of work, on a project-by-project basis. The type of material, source, and the percentage of the PC replaced shall be clearly indicated. Upon request, a Certified Test Report for the cement replacement material shall be provided to the Engineer for use during the Mix Design review.

1. Fly Ash: Fly ash to be used as a partial replacement for Portland cement shall meet the requirements of AASHTO M 295, either Class C or Class F, including the uniformity requirements of Table 2A. Loss on Ignition for either class of fly ash shall not exceed 4.0%. Fly ash may be used to replace up to a maximum of 20% of the required Portland cement for mixes without permeability requirements. For mixes with permeability requirements, the maximum of 20% may be exceeded. The fly ash shall be substituted on a weight basis, with a minimum of 1 lb. of fly ash for 1 lb. of Portland cement. Different classes of fly ash or the same class from different sources shall not be permitted on any single project without the written approval of the Engineer.

2. **Ground Granulated Blast Furnace Slag (GGBFS):** GGBFS used as a partial replacement for Portland cement shall meet the requirements of AASHTO M 302/ASTM C989, Grade 100 or 120. As determined by the Engineer, GGBFS may be used to replace a maximum of 30% of the required Portland cement for mixes without permeability requirements. For mixes with permeability requirements, the maximum of 30% may be exceeded. The Engineer may restrict or prohibit the use of GGBFS if ambient temperatures anticipated during the placement and initial curing of the concrete are low. The GGBFS shall be substituted on a weight basis, with a minimum of 1 lb. of slag for 1 lb. of Portland cement. Different sources of GGBFS shall not be permitted on any single project without the written approval of the Engineer.

4. Water: All water used in the mixing of concrete shall be odorless and clear in appearance. Surface water may be used if not taken from shallow or muddy sources; classified as Class C or Class D on the Department of Energy and Environmental Protection (DEEP) Water Quality Classification mapping; and accommodations have been made to prevent contaminants from entering the supply to the satisfaction of the Engineer. The Engineer may request that water from any surface or ground source be tested in accordance with AASHTO T26 and AASHTO D512 if the appearance or scent of the water is suspect. To be acceptable, the pH of the water must not be less than 6.0 or greater than 8.0 and Chloride Ion Concentration of the water must not exceed 250ppm. Potable water taken directly from a municipal or regional water supply may be used for mixing concrete without testing. Heating or cooling of water may be required to meet mix temperature requirements at time of placement.

5. Admixtures: All admixtures shall perform their function without injurious effects upon the concrete. If requested by the TDC, the Contractor shall present a certified statement from a recognized laboratory attesting to this requirement. A "recognized" laboratory is any cement and concrete laboratory approved and inspected regularly by the Cement and Concrete Reference Laboratory (CCRL). The statement shall contain results of compression tests of cylinder specimens made with concrete utilizing the admixture(s) in proportions equal to those proposed by the Contractor. The results of at least 5 standard 6 inch x 12 inch cylinders of each mix design shall be listed with the results of at least 5 like-sized cylinders not utilizing the admixture(s). Specimens must be made and cured in the laboratory in accordance with AASHTO T 126 and will be tested in accordance with AASHTO T 22.

- (a) Air-Entraining Admixtures:** In the event that air entrained concrete is required, an admixture meeting the requirements of AASHTO M 154 may be used. Tests for 7 and 28-day compressive and flexural strengths and resistance to freezing and thawing are required whereas tests for bleeding, bond strength and volume change will not be required.
- (b) Other Chemical Admixtures:** In the event that concrete properties are specified that require the use of additional admixtures, or the Contractor proposes the use of additional admixtures to facilitate placement, the admixtures shall meet the requirements of AASHTO M194M/M, including the 1 year performance data.

M.03.02—Mix Design Requirements

1. Standard ConnDOT Mix Designs: Standard Mix Designs shall be designed in accordance with applicable sections of ACI 211 and ACI 318. The mixtures shall consist of Portland cement, fine aggregate, coarse aggregate, admixtures, and water proportioned in accordance with Table M.03.02-1. The mixtures shall also be designed to obtain the plastic properties of Portland cement concrete as specified in Table 6.01.03-2.

Table M.03.02-1 Standard Portland Cement Concrete Mixes

Class ¹	Max. Water/Cement ² ratio	Min. Cement ² Content - lb./c.y.	Air Content %	Electrical Resistivity (Permeability) kΩ-cm AASHTO T 358
PCC0223Z	0.69	455	6 +/- 1.5	NA
PCC0334Z	0.48	615		NA
PCC0336Z	0.50	564		NA
PCC0354Z	0.49	615		NA
PCC0446Z	0.44	658		NA
PCC04462	0.42			29 minimum
PCC0556Z	0.40			NA
PCC05562	0.40			29 minimum
PCCXXX81 ³	0.46		7.5 +/- 1.5	15 maximum
PCCXXX82	0.40	29 minimum		

¹ PCCXYZ where:

PCC = Portland Cement Concrete

XXX = 28-day minimum compressive strength (psi/100)

Y = Nominal Maximum Aggregate Size (U.S. Sieve No. Designation)

Z = Exposure Factor (See Table M.03.02-1a)

² Portland Cement may be partially replaced within a Standard Mix Design by other approved cementitious material meeting the requirements of M.03.01-3(c) if permitted by the Engineer.

³ When this class is paid for in a surface or structural repair concrete item, the plastic properties necessary for confined placement to ensure appropriate workability for consolidation within the forms shall be noted on the delivery ticket by the concrete supplier.

Table M.03.02-1a Exposure Factor per Application

Exposure		Application
0	Benign	Elements not exposed to weather (buried, enclosed)
1	Moderate	Elements not in contact with salt water or deicing chemicals
2	Severe	Elements in contact with salt water, deicing chemicals, flowing/standing water

Mix designs shall indicate the dosage of admixtures anticipated to provide plastic properties required in the Project specification. Plastic properties of standard mix classes of concrete in the plastic state are listed in Table 6.01.03-2.

Standard Mix Designs are required to be designed and submitted by the concrete producers, and are approved by the Department on a standing basis. Submittal or re-approval of these Standard Mix Designs on an annual basis is not required. Previously approved producer-designed Standard Mixes that have a record of satisfactory performance may be utilized on Department projects unless there is a change in the gravimetric properties or the sources of any materials. Revisions to the Standard Mix Designs, which include changes in component sources, can be submitted at any time to the TDC, but must be approved prior to use on Department projects.

2. Non-Standard CTDOT Mix Designs: Any proposed Mix Designs that do not comply with Table M.03.02-1 are required to be submitted 15 days prior to use on a project-by-project basis and be approved by the TDC prior to use. The use of an approved admixture with an otherwise approved Standard Mix Design is not considered non-standard.

All Non-standard Mix Designs used for load-bearing structures shall contain a minimum of 658 lb./c.y. of cementitious materials.

Concrete used in applications such as flowable fill or controlled low-strength material may be designed with less than 658 lb./c.y. of cementitious materials.

M.03.03—Producer Equipment and Production Requirements

1. General Requirements: The source of the concrete must be approved by the Engineer prior to use on Department projects. Specifically the location and capacity of the central mix or dry batch plant, and complement of truck mixers/haulers, shall be adequate for continuous placement of concrete on a typical Department project. Approval may be revoked at any time in accordance with 1.06.01.

- (a) **Inspection:** The production facility supplying hydraulic cement concrete shall have a current Certification of Ready Mixed Concrete Production Facilities from the National Ready Mixed Concrete Association (NRMCA), or equivalent certification approved by the Engineer.
- (b) In addition to the requirements of approved third party certification, the facility shall produce batch tickets that meet the requirements of 6.01.03-3(a).
- (c) **Quality Control:** The Contractor is responsible for all aspects of Quality Control (QC). As determined by the Engineer, should material delivered to a project not meet specification, the Contractor may be required to submit to the Engineer a corrective procedure for approval within 3 calendar days. The procedure shall address any minor adjustments or corrections made to the equipment or procedures at the facility.
- (d) **Suspension:** As determined by the Engineer, repeated or frequent delivery of deficient material to a Department project may be grounds for suspension of that source of material. A detailed QC plan that describes all QC policies and procedures for that facility may be

required to formally address quality issues. This plan must be approved by the Engineer and fully implemented, prior to reinstatement of that facility.

2. Hand Mixed Concrete: Hand mixing shall be permitted only with the permission of the Engineer. Hand mixed batches shall not exceed 1/2 c.y. in volume. Hand mixing will not be permitted for concrete to be placed under water.

M.03.04—Curing Materials

1. Water: Any water source deemed acceptable by the Engineer for mixing concrete may be used to provide water for curing purposes. Surface water may be used if classified as Class C or Class D on the Department of Energy and Environmental Protection (DEEP) Water Quality Classification mapping and accommodations have been made to prevent contaminants from entering the supply to the satisfaction of the Engineer. In general, water shall not be taken from shallow or muddy sources. In cases where sources of supply are relatively shallow, the intake pipe shall be enclosed to exclude silt, mud, grass, etc.; and the water in the enclosure shall be maintained at a depth of not less than 2 feet under the intake pipe.

2. Mats: Mats for curing concrete shall be capable of maintaining moisture uniformly on the surface of the concrete. The mats shall not contain any materials such as dyes, sugar, etc., that may be injurious to the concrete.

The length or width of the mats shall be sufficient to cover all concrete surfaces being cured. Should more than one mat be required, sufficient overlap shall be provided by the Contractor as determined by the Engineer.

3. Liquid Membrane-Forming Compound: Liquid membrane-forming compound shall meet the requirements of AASHTO M 148 Type 2, Class B, or shall be a water-soluble linseed oil-based compound meeting the requirements of AASHTO M 148, Type 2.

4. White Polyethylene Sheeting (Film): White polyethylene sheeting (film) shall meet the requirements of AASHTO M 171.

M.03.05—Non Shrink, Non Staining Grout

1. Bagged (pre-mixed): Bagged (pre-mixed) formulations of non-shrink grout shall meet the requirements of ASTM C1107. The grout shall be mixed with potable water for use. The grout shall be mixed to a flowable consistency as determined by ASTM C230. All bagged material shall be clearly marked with the manufacturer's name, date of production, batch number, and written instructions for proper mixing, placement and curing of the product.

2. Bulk: The Contractor may formulate and design a grout mix for use on the Project in lieu of using a pre-bagged product. The Contractor shall obtain prior written approval of the Engineer for any such proposed Mix Design. Any such Mix Design shall include the proportions of hydraulic cement, potable water, fine aggregates, expansive agent, and any other necessary additive or admixture. This material shall meet all of the same chemical and physical requirements as shall the pre-bagged grout, in accordance with ASTM C1107.

M.03.06—Expansive Cement for Anchoring

The premixed anchoring cement shall be non-metallic, concrete gray in color and prepackaged. The mix shall consist of hydraulic cement, fine aggregate, expansive admixtures and water meeting the following requirements:

1. The anchoring cement shall have a minimum 24 hour compressive strength of 2,600 psi when tested in accordance with ASTM C109.

2. The water content of the anchoring cement shall be as recommended by the manufacturer. Water shall meet the requirements of M.03.01-4.

The Contractor shall provide a Certified Test Report and Materials Certificate for the premixed anchoring cement in accordance with 1.06.07. The Contractor shall also provide, when requested by the Engineer, samples of the premixed anchoring cement for testing and approval.

M.03.07—Chemical Anchors

Chemical anchor material must be listed on the Departments' Qualified Products List and approved by the Engineer for the specified use.

The chemical anchor material shall be epoxy or polyester polymer resin. It shall not contain any metals or other products that promote corrosion of steel. The Contractor shall supply the Engineer with a Certified Test Report and Materials Certificate for the chemical anchor material in accordance with 1.06.07. When requested by the Engineer, the Contractor shall also provide samples of the chemical anchor material.

M.03.08—Joint Materials

1. Transverse Joints for Concrete Pavement: Transverse joints shall consist of corrosion resistant load transfer devices, poured joint seal and in addition, in the case of expansion joints, expansion joint filler all meeting the following requirements:

- (a) The corrosion resistant load transfer device shall be coated steel or sleeved steel or be made of corrosion resistant material. The dimensions of any devices used shall be as shown on the plans, exclusive of any coating or sleeving. Core material of coated or sleeved metallic devices shall be steel meeting the requirements of AASHTO M 255M/M 255 Grade 520, or steel having equal or better properties and approved by the Engineer. Nonmetallic devices shall meet the various strength requirements applicable to metallic devices as well as all other requirements stated herein.
- (b) All coated load transfer devices shall meet the requirements of AASHTO M 254. Uncoated or sleeved load transfer devices shall meet the applicable physical requirements of AASHTO M 254. The use of field applied bond breakers will not be permitted.
- (c) The basis of acceptance for corrosion resistant load transfer devices shall be the submission by the Contractor of a minimum of 2 samples accompanied by Certified Test Reports meeting the requirements of 1.06.07 demonstrating that the load transfer device meets the requirements of AASHTO M 254 for the type of device supplied. The Engineer reserves the right to reject any load transfer device deemed unsatisfactory for use.

2. Joint Filler for Concrete Curbing: Expansion joint filler shall be either preformed expansion joint filler or wood joint filler as indicated on the plans and shall meet the following requirements:

- (a) Preformed expansion joint filler shall be the bituminous cellular type and shall meet the requirements of AASHTO M 213.
- (b) Boards for wood joint filler shall have 2 planed sides and shall be redwood, cypress or white pine. Redwood and cypress boards shall be of sound heartwood. White pine boards shall be of sound sapwood. Occasional small, sound knots and medium surface checks will be permitted provided the board is free of any defects that will impair its usefulness for the purpose intended. The joint filler may be composed of more than one length of board in the length of the joint, but no board of a length less than 6 feet shall be used; and the

separate boards shall be held securely to form a straight joint. Boards composed of pieces that are jointed and glued shall be considered as one board.

- (c) Dimensions shall be as specified or shown on the plans; and tolerances of plus 1/16 inch thickness, plus 1/8 inch depth and plus 1/4 inch length will be permitted.
- (d) All wood joint filler boards shall be given a preservative treatment by brushing with creosote oil meeting the requirements of AASHTO M 133. After treatment, the boards shall be stacked in piles, each layer separated from the next by spacers at least 1/4 inch thick; and the boards shall not be used until 24 hours after treatment. Prior to concreting, all exposed surfaces of the wood filler shall be given a light brush coating of form oil.
- (e) Testing of board expansion joint filler shall be in accordance with pertinent sections of AASHTO T 42.

3. Longitudinal Joint Devices: The metal used in the fabrication of longitudinal joint devices shall meet ASTM requirements for each type of metal used. The dimensions shall be as shown on the plans.

4. Expansion Joint Fillers for Bridges and Bridge Bearings:

- (a) Preformed expansion joint filler for bridges shall meet the requirements of AASHTO M 153, Type I or Type II.
- (b) Pre-molded expansion joint filler for bridge bearings shall meet the requirements of AASHTO M 33.

5. Joint Sealants:

(a) **Joint Sealer for Pavement:** The joint sealer for pavement shall be a rubber compound of the hot-poured type and shall meet the requirements of AASHTO M 324 Type II unless otherwise noted on the plans or in the special provisions.

(b) **Joint Sealer for Structures:** Structure joint sealers shall be one of the following type sealants:

1. Where "Joint Seal" is specified on the plans, it shall meet the requirements of the Federal Specifications SS-S-200-E (Self-leveling type), TT-S-0227E (COM-NBS) Type II-Class A (Non-sag type), or 1 component polyurethane-base elastomeric sealants conforming to FS TT-S-00230C Type II-Class A or an approved equal.

A Certified Test Report will be required in accordance with 1.06.07, certifying that the sealant meets the requirements set forth in the Federal Specification. Should the consignee noted on a Certified Test Report be other than the Prime Contractor, a Materials Certificate shall be required to identify the shipment.

2. Where "Silicone Joint Sealant" is specified on the plans, it shall be one of the following or an approved equal:
 - i. Sealant, manufactured by the Dow Corning Corporation, Midland, Michigan 48686-0994
 - ii. Dow Corning 888 Silicone Joint Sealant or
 - iii. Dow Corning 888-SL Self-Leveling Silicone Joint 48686-0994

6. Closed Cell Elastomer: The closed cell elastomer shall meet the requirements of ASTM D1056, Grade RE-41 B2. The elastomer shall have a pressure-sensitive adhesive backing on one side.

The Contractor shall deliver the closed cell elastomer to the job site a minimum of 30 days prior to installation. Prior to the delivery of the closed cell elastomer, the Contractor shall notify the Engineer of the date of shipment and the expected date of delivery. Upon delivery of the closed cell elastomer to the job site, the Contractor shall immediately notify the Engineer.

Each separate length, roll or container shall be clearly tagged or marked with the manufacturer's name, trademark and lot number. A lot is defined as that amount of closed cell elastomer manufactured at 1 time from 1 batch of elastomer. A batch is defined as that amount of elastomer prepared and compounded at 1 time. The Contractor shall furnish a Certified Test Report in accordance with 1.06.07, confirming that the closed cell elastomer meets the requirements set forth in these specifications. Should the co-signee noted on a Certified Test Report be other than the Prime Contractor, a Materials Certificate shall be required to identify shipment.

The Contractor shall furnish a 1 foot length of closed cell elastomer in each lot for purposes of inspection and testing by the Engineer. The Engineer will cut a 1 foot sample from each lot and inspect the sample for conformance to size, and perform physical tests on the sample as deemed necessary.

The Engineer shall reject any lot or portion of a lot that does not meet the requirements stated herein. A rejected lot or portion of a lot may be resubmitted provided the Contractor has removed or corrected, in a manner acceptable to the Engineer, all non-conforming material.

M.03.09—Protective Compound/Sealers

The brand and type of material must be listed on the Department's Qualified Products List and approved by the Engineer for the specified use.

M.03.10—Formwork

1. Stay-in-place Forms: Material for stay-in-place metal forms shall be made of zinc-coated (galvanized) steel sheet meeting ASTM Specification A653 (Structural Steel (SS) Grade 33 through 80). The minimum thickness shall be 20 gauge. Coating weight shall meet the requirements of ASTM A924, Class G235, and shall otherwise meet all requirements relevant to steel stay-in-place metal forms and the placing of concrete as specified herein and as noted in the Contract.

Form supports shall either be fabricated and meet the same material requirements as the forms, or be fabricated from structural steel meeting the requirements of ASTM A36 and shall be hot-dip galvanized in accordance with ASTM A123.

Lightweight filler material for forms shall be as recommended by the form manufacturer.

2. Temporary Forms and Falsework: Forms and Falsework shall be of wood, steel or other material approved by the Engineer. This approval does not relieve the Contractor from employing adequately sized materials of sufficient rigidity to prevent objectionable distortion of the formed concrete surfaces caused by pressure of the plastic concrete and other loads incidental to the construction operations.

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 journeyman 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 journeyman, 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 0 (%) 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.

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:

Table with 5 columns: 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. Includes a row for 'TOTALS' with dollar signs.

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

EXHIBIT II

CERTIFICATION OF WORK TO BE SUBCONTRACTED

Mar.01

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

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

Title _____

EXHIBIT III

CERTIFICATION
PAST CONSTRUCTION EXPERIENCE

Mar.01

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
Contractor/Small Contractor MBE person, firm, association or corporation)
_____ is a certified Small Contractor/Small
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 #0000985A - TRACK MONITORING

Description: The Contractor shall monitor track horizontal and vertical movement in accordance with this special provision as follows:

Survey work shall be performed by a Registered Land Surveyor in the State of Connecticut. Survey crew should be trained under AMTRAK's Railroad's Safety Contractor/Leasee Employee Training program and maintain certification for the duration of the work.

Railroad traffic shall be maintained at all times with safety and continuity, and Contractors shall conduct their operations in compliance with all rules, regulations, and requirements of Railroad (including these Specifications) with respect to any work performed on, over, under, within or adjacent to Railroad's property. Contractors shall be responsible for acquainting themselves with such rules, regulations and requirements. Any violation of Railroads safety rules, regulations, or requirements shall be grounds for the immediate suspension of the Contractor work, and the re-training of all personnel, at the Contractor's expense.

Scope: If any work that could potentially affect the stability of the track is occurring within 50 feet of a track, or within the influence line of a track, then monitoring points shall be established along the track. The influence line descends from a point one foot horizontally away from the outside end of the tie bottom one unit vertically for every unit and a half horizontally.

Safety: All work close enough to foul a track must only be performed under the direction of qualified railroad personnel. People performing track monitoring are classified as Roadway Workers and must be trained in Roadway Worker Protection.

Points: Each location shall include a point on the top of rail marked with paint or crayon on the field side of the rail and used for vertical measurements, and a point on the tie for horizontal measurements. In wood ties, the point shall be marked with a PK nail or similar surveyor's marker; on concrete or steel ties the point shall be marked with paint.

Point Locations: Reference points shall be established along the track beginning at the point where the work is closest to the track. Points shall continue to be placed at intervals of 50 feet along the track to the point where the work ends or does not meet the conditions outlined above, and then at 50 feet, 100 feet, and 200 feet away from the end point(s). Where more than one track may be affected, points shall be established on each track that could be affected.

Measurement Accuracy: Monitoring points shall be established to within 0.001 feet, and monitoring shall be done to 0.01 feet.

Monitoring: Monitoring shall be performed at the beginning and end of every shift of work. Points shall be measured, the measurements recorded, and the numbers compared with previous measurements. All points shall be measured each time monitoring occurs, except for the points

200 feet away from the end of work; these points shall only be measured if any of the other measurements exceeds an allowable deviation.

Allowable deviations: If track is found to have moved either vertically or horizontally by more than one half of the Amtrak Maintenance limits as specified in Amtrak’s MW-1000 for the particular class of track involved, then all work shall cease immediately and the contractor shall immediately notify the designated Amtrak Project Engineer. Work may not resume until the designated Amtrak Project Engineer has inspected the site and approved.

Track Maintenance: Deficiencies in track surface and alignment caused by construction activities shall be corrected solely by Amtrak forces at project expense.

TRACK CLASS	MAX. PASSENGER SPEED (MPH)	CROSS LEVEL (INCHES) The Difference in Cross Level Between Any Two Points Less Than		DEVIATION FROM UNIFORM PROFILE (INCHES)		DEVIATION FROM HORIZONTAL ALIGNMENT (INCHES)	DEVIATION FROM HORIZONTAL ALIGNMENT (INCHES)
		10'	62'	31' CHORD	62' CHORD	31' CHORD	62' CHORD
MAINTENANCE LIMITS							
1	15	1	2 ¼	N/A	2 ¼	2 ¾	3 ¾
2	30	1	1 ⅝	N/A	2	1 ½	2 ¼
3	60	1	1 ½	N/A	1 ⅝	7/8	1 ¼
4	80	1	1 ¼	N/A	1 ½	¾	1
5	90	1	1 ⅛	N/A	1	¾	½
6	110	¾	1	¾	¾	¾	½
7	125	¾	1	¾	¾	¾	¾
8	160	¾	1	½	¾	¾	¾
9	200	¾	1	¾	½	¾	¾
½ MAINTENANCE LIMITS							
1	15	½	1 ⅛	N/A	1 ⅛	1 ⅜	1 ⅞
2	30	½	13/16	N/A	1	¾	1 ⅛
3	60	½	¾	N/A	13/16	7/16	5/8
4	80	½	5/8	N/A	¾	¾	½
5	90	½	9/16	N/A	½	3/16	¼
6	110	¾	½	¾	¾	3/16	¼
7	125	¾	½	¾	¾	3/16	3/16
8	160	¾	½	¼	¾	3/16	3/16
9	200	¾	½	3/16	¼	3/16	3/16

Materials: As determined by the Contractor and approved by the Engineer and Amtrak.

Construction Methods: The Contractor shall submit a detailed method of track monitoring to the Engineer and Amtrak for review and approval prior to performing any sheet pile driving within 50 feet of the track and/or any excavation or directional drilling operations under the tracks.

Method of Measurement: This work will be paid for on a lump sum basis and will not be measured for payment.

Basis of Payment: This work will be paid for at the contract lump sum price for “Track Monitoring”, which price shall include all materials, equipment, tools, and labor incidental thereto.

Pay Item	Pay Unit
Track Monitoring	l.s.

ITEM #0063521A - RAIL FACILITY UPGRADE SITE NO. 1

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 817 Article 1.20-1.02.01 and 1.02-1.03.01 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 “Rail Facility Upgrade Site No. 1” complete.

Basis of Payment: This item will be paid for at the contract lump sum price for “Rail Facility Upgrade Site No. 1”, which price shall include all administrative and procedural requirements, material, equipment, labor, and work incidental thereto.

<u>Pay Item</u>	<u>Pay Unit</u>
Rail Facility Upgrade Site No. 1	LS

ITEM #0100500A - CONSTRUCTION COMMUNICATION EQUIPMENT

Description: Under this item, the Contractor shall provide the communication equipment for use by the CTDOT forces. This item shall include all necessary equipment, accessories, material and labor to put the system into operation. Provisions shall also be made to maintain all provided communication equipment and any additional communication equipment assigned to the project, as directed by the Engineer.

Materials: Materials, supplies and equipment shall be in like new condition as approved by the Engineer.

Any supplies required to maintain or operate the equipment above listed above shall be provided by the Contractor for the duration of the project at no additional charge.

Once the Contract has been completed, the computer will remain the property of the Contractor. Prior to the return of any computer(s) to the Contractor, field personnel will coordinate the removal of Department owned equipment, software, data, and associated equipment.

Computer Hardware and Software:

The computer system furnished shall have all software and hardware necessary for the complete installation of the latest versions of the software listed, and therefore supplements the minimum specifications below.

The Contractor shall provide the Engineer with a licensed copy registered in the Department's name of the latest versions of the software listed and maintain customer support services offered by each software producer for the duration of the Contract. The Contractor shall deliver to the Engineer all supporting documentation for the software and hardware including any instructions or manuals.

The Contractor shall provide the computer system with all required supplies, maintenance and repairs (including labor and parts) throughout the Contract life.

Note: Before ordering the computer hardware and software, the Contractor must submit a copy of their proposed PC specifications to the CTDOT Project Engineer for review. If the specification meets or exceeds the listed minimum specifications, then the Contractor will be notified that the order may be placed.

Arrangements must be made a minimum of 24 hours in advance of delivery of computer equipment to the District Office. Arrangements should be made by contacting the CTDOT Project Engineer. All software, hardware and licenses listed below shall be clearly labeled, specifying the (1) Project No., (2) Contractor Name, (3) Project Engineer's Name and (4) Project Engineer's Phone No.

Construction Methods:

Before ordering the computer hardware and software, the Contractor must submit a copy of their proposed PC specifications to the CTDOT Project Engineer for review. If the specification meets or exceeds the listed minimum specifications, then the Contractor will be notified that the order may be placed.

Arrangements must be made a minimum of 24 hours in advance of delivery of equipment to the District Office. Arrangements should be made by contacting the CTDOT Project Engineer. All software, hardware and licenses listed below shall be clearly labeled, specifying the (1) Project No., (2) Contractor Name, (3) Project Engineer’s Name and (4) Project Engineer’s Phone No.

Method of Measurement: The item, Construction Communication Equipment, will be measured for payment based on actual detailed invoices.

Basis of Payment: 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 item, “Construction Communication Equipment”, will be paid for at the actual detailed monthly account history for services approved by the Engineer, plus a 5% markup. Payment will include all materials, equipment, labor and maintenance associated with this item.

Pay Item	Pay Unit
Construction Communication Equipment	est.

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 AOECs. Work under this Item consists of the development and implementation of a written HASP that addresses the relative risk of exposure to documented 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 health and safety plan which is compatible with the Contractor's plan 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:

1-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".

2-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 limits of the AOECs, as identified in the Contract Documents, and in other areas identified by the Engineer or by the HASP where site conditions may pose a risk to worker health and safety and/or the environment. **No physical aspects of the work within the AOECs 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.

3-Regulatory Requirements: All construction related activities performed by the Contractor within the limits of the AOECs or in other areas where site conditions may pose a risk to worker health and safety and/or the environment 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.

4-Submittals: Three copies 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 work in the AOECs, 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(s) within four (4) weeks of submittal and provide written comments as to deficiencies in and/or exceptions to the plan(s), 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 work activities in the AOECs, as shown on the Plans, or where site conditions exist which may pose a risk to worker health and safety and/or the environment, until the HASP has been reviewed and accepted 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.

5-HASP Provisions:

(a) 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 the topic.

(b) Elements:

(i) 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.

(ii) 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.

(iii) 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.

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. Typical team

members include but are not limited to Team Leader, Scientific Advisor, Site Safety Officer, Public Information Officer, Security Officer, Record Keeper, Financial Officer, Field Team Leader, and Field Team members.

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 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:

- (A) Directing and implementing the HASP.
- (B) 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.
- (C) Authorizing Stop Work Orders, which shall be executed upon the determination of an imminent health and safety concern.
- (D) 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.
- (E) Authorizing work to resume, upon approval from the Contractor's HSM.
- (F) Directing activities, as defined in the Contractor's written HASP, during emergency situations; and

(G) Providing personal monitoring where applicable, and as identified in the HASP.

(iv) 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.

(v) Personal Protective Equipment: The plan 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 personal protective equipment (PPE) to insure 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.

(vi) 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.

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

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

(ix) Communications: Written procedures for routine and emergency communications procedures shall be included in the Contractor's HASP.

(x) Personal Hygiene, Personal Decontamination and Equipment Decontamination: Decontamination facilities and procedures for personnel protective equipment, sampling equipment, and heavy equipment shall be discussed in detail in the HASP.

(xi) 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.

(xii) 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.

(xiii) 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 to the Engineer an accident report.

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

(xv) 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.

(xvi) 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.

6-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 personal protective equipment (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., which 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 the WSA until the material is appropriately disposed.

7-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:

1-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:

- (a) The development costs associated with preparing the HASP in accordance with these Specifications.
- (b) The cost per month for the duration of the Project to implement the HASP and provide the services of the HSM and the HSO.

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

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

- (a) The lump sum development cost will be certified for payment.
- (b) 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.
- (c) 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.
- (d) Failure of the Contractor to implement the HASP in accordance with this Specification shall result in the withholding of all Contract payments.

Basis of Payment:

This work will be paid for at the Contract lump sum price for “Environmental Health and Safety” which price 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, chemical protective clothing (CPC), personal protective equipment (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	L.S.

ITEM #0101117A - CONTROLLED MATERIALS HANDLING

Description:

Work under this Item is intended to provide specific operational and maintenance requirements at the **existing** waste stockpile area (WSA) located along State Route 75 and bounded by the Interstate-91 Exit 38 northbound off-ramp area in Windsor (designated on Project Plan ENV-03) and in accordance with Contract Documents. In addition, there are procedural requirements that the Contractor is to follow during the excavation of Controlled Materials from Area of Environmental Concern (AOEC)-1 or AOEC-2 and transported to the WSA. This supplements all Specification Items that involve excavation and Contract Special Provisions for excavation wherever contaminated materials are encountered. All materials, excluding the existing pavement structure (asphalt and subbase), rock, ledge, miscellaneous debris, utilities, structures, and concrete excavated from AOEC-1 or AOEC-2 that cannot be reused within the Project limits are to be considered Controlled Materials. If the vertical limits of the existing subbase cannot be determined visually, subbase will be presumed to extend 12 inches below the bottom of the existing pavement. Work under this item shall include repair, replacement, and/or resetting of construction blocks, damaged asphalt, the existing anti-tracking pads and chain link fence and gate(s); cleaning of any existing catch basin(s) and pipes(s) at the WSA; stockpiling of the excavated materials at the WSA, and covering, securing, and maintaining the stockpiled materials throughout the duration of the Project. It is noted that one (1) WSA bin will be made available for temporary Controlled Materials storage during the project as the remaining bins are reserved for a different project. Additionally, the WSA is to be used for temporary storage of Controlled Materials only and not for storage of any Contractor equipment or supplies.

Controlled Materials consisting of non-hazardous levels of regulated substances have been documented to exist within the Project limits. Such contamination is documented in the reports listed in the "Notice to Contractor – Environmental Investigations". Where contaminated soils are excavated, such soil will not be reusable as backfill, unless authorized by the Engineer in writing, and will require special handling, disposal, and documentation procedures.

Materials:

The required materials are detailed on the Project Plans. All materials shall conform to the requirements of the Contract.

Anti-tracking pad shall conform to the requirements of Item #210100.

Bituminous concrete pad shall conform to Section 4.06.02 of the Specifications.

Construction blocks shall be solid precast rectangular concrete 6 feet meters in length, 3 feet in height, and 2 feet in width.

Chain link fence and gate shall conform to Section 9.13 of the Specifications.

Hay bales shall conform to the requirements of Section 2.18.02 of the Specifications.

Polyethylene plastic sheeting for underlayment shall be at least 30 mil thick. Polyethylene plastic sheeting for covering excavated material shall be a thickness of 10 mil. Both shall be at least 10 feet wide.

Roll-off/Storage containers shall be of watertight, steel-body construction, of the size specified and able to handle the storage and subsequent transportation of material to the disposal facility.

Covers for roll-off/storage containers shall be made of polyethylene plastic, or similar watertight material, that is of sufficient size to completely cover top opening and can be securely fastened to the container.

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

Bedding sand shall conform to Article M.08.03 of the Specifications.

Construction sign shall conform to Section 12.20 of the Specifications.

Sorbent boom shall be 8 inches in diameter and 10 feet long and possess petrophilic and hydrophilic properties. Sorbent booms shall also have devices (i.e. clips, clasps, etc.) for connection to additional lengths of boom.

Construction Methods:

A. General

When Controlled Materials are encountered 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.

Excavated material from AOECs, if suitable, may be reused within the AOECs from which it was excavated, in accordance with the following conditions: (1) such soil is deemed to be structurally suitable as fill by the Engineer; (2) such soil is not placed below the water table; (3) the CT DEEP groundwater classification of the area where the soil is to be reused as fill does not preclude said use; and (4) such soil is not placed in an area subject to erosion. Materials removed from any excavation within an AOEC which cannot be immediately reused within the same AOEC shall be transported directly from their point of origin on the Project to the WSA. The stockpiles of excavated controlled materials shall be maintained as shown on the Project Plans. The Contractor shall plan excavation activities within AOECs in consideration of the capacity of WSA, and 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 stockpile 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 determinations. **No delay claim will be considered based upon 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 materials:

1. Transported Controlled Materials are to be covered prior to leaving the point of generation and are to remain covered until the arrival at the WSA;
2. All vehicles departing the site are properly logged to show the vehicle identification, driver's name, time of departure, destination, and approximate volume and content of materials carried;
3. All vehicles shall have secure, watertight containers free of defects for material transportation;
4. No material shall leave the site until there is adequate lay down area prepared in the WSA; and,
5. Documentation must be maintained indicating that all applicable laws have been satisfied and that the materials have been successfully transported and received at the WSA.

All repairs to and re-establishment of the existing WSA, including anti-tracking pads, shall be completed and approved by the Engineer prior to the initiation of construction activities generating Controlled Materials. Polyethylene sheeting and other measures shall be implemented to divert rainfall away from the WSA.

No Controlled Materials shall be excavated or transported to the WSA until registration under the “General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer)” has been obtained by the Connecticut Department of Transportation (ConnDOT).

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

Excavated materials shall be staged as shown on the Project Plans or 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 WSA; replacement of damaged components (i.e. sand bags, plastic polyethylene sheeting, construction blocks, chain link fence and gate, etc.); and waste inventory record management. The Contractor shall manage all materials in the WSA in such a way as to minimize tracking of potential contaminated materials across the site and off-site, and minimize dust generation.

Anti-tracking measures shall be replaced at the WSA to ensure the vehicles do not track soil from the WSA onto a public roadway at any time.

A sign shall be posted and maintained that is visible from a distance of at least 25 feet at the WSA identifying the name of the permittee (State on Connecticut, Department of Transportation (DOT)), the DOT field office phone number, the hours of operation for the WSA, and the phrase, “Temporary Soil Staging Area”. Lettering shall be at least 2 inches high with a minimum overall sign dimension of 4 feet wide by 1 foot high. Such sign is only required if the capacity of the WSA is equal to or greater than 1,000 cubic yards. If initially the WSA capacity is less than 1,000 cubic yards and the WSA capacity is subsequently increased, the Contractor shall post and maintain the required sign at no additional cost to the State, prior to stockpiling the additional material.

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 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 plastic 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 to the environment from the piles.

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; any materials loaded and transported for on-site reuse; and identification of stockpiles relative to their points of generation.

Following the removal of all stockpiled Controlled Materials, residuals shall be removed from 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. If the results from dry methods are unsatisfactory to the Engineer, the Contractor shall modify decontamination procedures as required.

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, between stages of the work, or between work in different AOECs.

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 operations associated with Controlled Materials. It shall be the Contractor's responsibility to supervise fugitive dust control measures and to monitor airborne particulate matter and included herein at no additional cost to the State. 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 Connecticut Department of Energy and Environmental Protection (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, operate, maintain, and repair the 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. Prevent unauthorized entry onto the stockpiles by the use of fences, gates, or other natural or artificial barriers.
4. Separate incidental excavation waste to the satisfaction of the receiving facility or to an extent that renders the contaminated soil and/or sediment suitable for its intended reuse.
5. Isolate and temporarily store incidental waste in a safe manner prior to off-site transport to a facility lawfully authorized to accept such waste.
6. Not store more than 100 cubic yards of incidental waste at any one time.
7. Sort, separate, and isolate all hazardous waste from contaminated soil and/or sediment.
8. Prevent or minimize the transfer or infiltration of contaminants from the stockpiles to the ground as detailed in “B. Transportation and Stockpiling” above.
9. Securely cover each stockpile of soil as detailed in “C. WSA Maintenance” above.
10. Minimize wind erosion and dust transport as detailed in “F. Dust Control” above.
11. Use anti-tracking measures at the WSA to ensure the vehicles do not track soil from the WSA onto a public roadway at any time.

12. 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.).
13. 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.
14. 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 MATERIAL HANDLING” will be measured for payment by the number of cubic yards of Controlled Material excavated within AOEC-1 or AOEC-2 and taken to the WSA. Material kept in proximity to the excavation and reused as it is generated will not be measured for payment under this item. This measurement shall be in accordance with and in addition to the quantity measured for the payment of the applicable excavation item(s) in Specifications 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 this material.

The repair, replacement, and resetting of construction blocks, damaged asphalt, existing anti-tracking pads, and chain link fence and gates(s); and the cleaning of the existing catch basin (s) and pipe(s) will not be measured separately for payment.

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 all materials, tools, labor, equipment, permits, and work needed to repair or replace construction blocks, damaged asphalt, existing anti-track pads, and chain link fence and gate(s); clean the existing catch basin(s) and pipe(s); install and maintain the construction sign; temporary stockpiling of Controlled Materials at the WSA; covering, securing, and maintaining the individual stockpiles within the WSA throughout the duration of the Project, and shall include site cleanup and abandonment.

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, tools, 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”.

Handling and disposal of contaminated groundwater is not anticipated for this Project.

Payment for dust control activities shall be made under the appropriate Contract items.

Pay Item	Pay Unit
Controlled Materials Handling	C.Y.

ITEM #0202315A - DISPOSAL OF CONTROLLED MATERIALS

Description:

Work under this item shall consist of the loading, transportation and final off-site disposal/recycling/treatment of controlled materials (excluding dewatering fluids) that have been generated from various excavations within the AOECs, brought to the WSA and determined to be contaminated with regulated substances at non-hazardous levels. This contamination is documented in the reports listed in the “Notice to Contractor – Environmental Investigations.” The results contained in the environmental investigation reports listed in the “Notice to Contractor – Environmental Investigations” show levels of various contaminants that the Contractor may encounter during construction. Actual levels found during construction may vary and such variations will not be considered a change in condition provided the material can still be disposed as non-hazardous at one or more of the disposal facilities listed herein. The controlled materials, after proper characterization by the Engineer, shall be taken from the WSA, loaded, transported to and treated/recycled/disposed of 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 materials:

Advanced Disposal Services Greentree Landfill 635 Toby Road Kersey, PA 15846 (814) 265-1744; Tony LaBenne	Allied Waste Niagara Falls Landfill, LLC 5600 Niagara Falls Boulevard Niagara, NY 14304 (716) 285-3344; David Hanson
Clean Earth of Carteret 24 Middlesex Avenue Carteret, NJ 07008 (732) 541-8909; Cheryl Coffee	Clean Earth of Connecticut (Formerly Phoenix Soil, LLC) 58 North Washington Street Plainville, CT 06062 (860) 747-8888; Dave Green
Clean Earth of Southeast Pennsylvania, Inc. 7 Steel Road Morrisville, PA 19067 (215) 428-1700; Joe Siravo	Clean Earth of Philadelphia, Inc. 3201 S. 61 Street Philadelphia, PA 19153 (215) 724-5520; Mike Kelly
Clinton Landfill 242 Church Street Clinton, MA 01510 (978) 365-4110; Chris McGown	Colonie Landfill Waste Connections, Inc. 1319 Loudon Road Cohoes, NY 12047 (518) 786-7331; Eric Morales
Coplay Aggregates Regulated Fill Site 5101 Beekmantown Road Whitehall, PA 18052 (610) 262-3804; Brian Hilliard	Dudley Reclamation Project 123 Oxford Avenue Dudley, MA (978) 663-2623; Jarrett Everton

ESMI of New Hampshire, LLC 67 International Drive Louden, NH 03307 (603) 783-0228; Steve Bennett	ESMI of New York, LLC 304 Towpath Road Fort Edward, NY 12828 (518) 747-5500; Peter Hansen
Manchester Landfill 311 Olcott Street Manchester, CT 06040 (860) 647-3248; Brooks Parker	Hazelton Creek Properties, LLC* 280 South Church Street Hazelton, PA 18201 (570) 207-2000; Allen Swantek
Red Technologies Soil 232 Airline Avenue Portland, CT 06980 (860) 342-1022; Christopher Wingdale	Ontario County Landfill 3555 Post Farm Road Stanley, NY 14561 (603) 235-3597; Scott Sampson
Soil Safe, Inc. 378 Route 130 Logan Township Bridgeport, NJ 08085	Republic Services Conestoga Landfill 420 Quarry Road Morgantown, PA 19543 (717) 246-4640; James Kuhn
Ted Ondrick Company, LLC 58 Industrial Road Chicopee, MA 01020 (413) 592-2565; Alan Desrosiers	Rhode Island Resource Recovery Corporation 65 Shun Pike Johnston, RI 02919 (401) 942-1430 ext. 211; Daniel Szetela
The Southbridge Recycling and Disposal Park 165 Barefoot Road Southbridge, MA 01550 (508) 765-9723; Tracey Markham	Turnkey Landfill - Waste Management of NH; TLR III Refuse Disposal Facility 90 Rochester Neck Road P.O. Box 7065 Rochester, NY 03839 (603) 330-2170; Ellen Bellio
Tunnel Hill Reclamation 2500 Township Road 205 Route 2 New Lexington, OH 43764 (914) 713-0203; William Gay	Waste Management RCI Fitchburg Landfill Fitchburg Princeton Road Westminster, MA 01473 (974) 355-6821; Frank Sepiol

* Note: each bin will require an additional 10 days (or more) for PADEP to review analytical data and approve material for disposal prior to facility acceptance of material. This is in addition to all other restrictions and wait periods defined below.

The above list contains treatment/recycle/disposal facilities which can accept the waste stream 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 material generated by the project.

Construction Methods:

A. Material Disposal

The Engineer will sample materials stored at the WSA at a frequency established by the selected treatment/recycling/disposal facilities. 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 taken. 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 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 (such as 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(s). 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 Federal and State regulations. **No claim will be considered based on the failure of the Contractor's selected disposal facility(s) 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. If creosote treated timbers are removed, they will be disposed of under the item "Disposal of Contaminated Timber Piles", "Disposal of Contaminated Railroad Ties" or in accordance with Article 1.04.05 in the absence of such items.

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 truck load 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 polices, the Contractor shall adhere to the following precautions during the transport of controlled materials off-site:

- 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 the arrival at the selected treatment/recycling/disposal facility.
- 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.
- 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, between stages of the work, and between work in different AOEC's.

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.

Following the removal of all stockpiled Controlled Materials from the WSA, residuals shall be removed from surfaces 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. 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, 2.06, and 2.86, 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.

The disposal of excavated materials, originally anticipated to be controlled materials, but determined by characterization sampling not to contain concentrations of regulated chemicals (non-polluted or “clean” materials) will not be measured for payment under this item but will be considered as surplus excavated materials and will be paid in accordance with Article 1.04.05.

Any materials stored in the WSA, and which are reused within Project limits, will not be measured for payment under this item. This material will be paid for under Item 0202318A – Management of Reusable Controlled Material or in accordance with Article 1.04.05 in the item’s absence.

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 other than creosote treated wood, 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 WSA 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 WSA; 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:

Test pits shall be performed for determining the location of underground utilities. This work shall consist of the removal and satisfactory disposal of all materials, the removal of which is necessary for the proper completion of the work, at the locations shown on the plans or as ordered, and backfilling, all in accordance with these specifications.

Utility facilities to be located shall include, but are not limited to, pipes, conduits, service connections, structures, tanks, utility appurtenances, and miscellaneous items such as telltales/markers on the existing pipes, etc.

Construction Methods:

Test pits shall be made in conformity with the requirements of the plans or as ordered. The Contractor shall furnish and employ such shores, 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. All bracing, etc., shall be removed when no longer required for the construction or safety of the work.

Wherever portions of existing full-depth bituminous concrete pavement are to be removed in conjunction with test pits, they shall be removed to neat lines. Where the limits of the areas in which such bituminous pavement is to be removed are adjacent to existing bituminous concrete pavement that is to remain in place, the limits shall be cut by a method approved by the Engineer.

The Contractor shall perform field surveys to establish the horizontal and vertical location and to document the type and size of the utilities at each test pit. The work shall be performed in accordance with the requirements of Section 9.80, Construction Staking. The Contractor shall furnish the Engineer copies of all test pit data.

After the test pit is completed, the Contractor shall notify the Engineer; and no backfill material shall be placed in the excavated area until the Engineer has approved the depth of excavation.

When backfilling is required, the material used shall be of a quality satisfactory to the Engineer and shall be free from large or frozen lumps, wood and other extraneous material. All backfill placed below subgrade shall be placed in layers of not more than 6 inches in depth after compaction and shall be thoroughly compacted by means of mechanical rammers or vibrators or by pneumatic tampers. Hand tampers shall be used only upon written permission of the Engineer. Unless otherwise ordered by the Engineer, the backfill shall be brought to the surface of the surrounding ground or subgrade and neatly graded.

All suitable material removed in making the excavation shall be used for backfill, if required. All surplus or unsuitable material shall be removed and disposed of as directed. Should additional material be required for backfilling, it may be obtained from the project excavation or from borrow pits, gravel pits, or elsewhere as the Engineer may direct.

Method of Measurement:

Test pits will be measured as each excavated, backfilled, surveyed, and accepted. There will be no separate measurement for mobilization and demobilization associated with this item.

Basis of Payment:

The quantities accepted for payment will be paid for at the contract unit price for the “Test Pit”, complete in place and accepted, which price shall include all materials, equipment, tools, surveys, and labor incidental thereto.

The price shall also include backfilling where required and the disposal of surplus material. No additional payment will be made for shoring, bracing, pumping, bailing or for material or equipment necessary for the satisfactory completion of the work.

If gravel fill or borrow are used for backfill, payment will be made at their respective contract unit prices.

Pay Item

Pay Unit

Test Pit

Each

ITEM #0603169A - PROGRESS PHOTOGRAPHS

Description: Under this item, the Contractor shall engage a qualified commercial photographer to take photographs during construction. The photographer shall be a firm or an individual of established reputation that has been regularly engaged as a professional photographer for not less than 3 years.

At the Preconstruction Meeting, submit to the Designer for approval the name of the photographer whom will be responsible for taking the photographs during construction.

Submit photos of each view within seven (7) calendar days of taking photographs. Four (4) photographic sets of photos shall be submitted. ALL photos shall be submitted in IBM-PC compatible digital format on compact disc (CD). Other than the photo thumbnail index required for submission with each CD, no other hardcopy photos shall be required for the project. One (1) set of photos (on CD) of each submittal shall be sent directly to each of the following offices:

1. Manager of State Design, Office of Facilities Design, Connecticut Department of Transportation, 2800 Berlin Turnpike, P.O. Box 317546, Newington, CT 06131-7546, Attention: Mr. Scott A. Hill, Room 3405NW.
2. District 1 Construction, Connecticut Department of Transportation, Project Chief Inspector's Construction Trailer.
3. Bureau of Public Transportation, Office of Rail, Connecticut Department of Transportation, 2800 Berlin Turnpike, P.O. Box 317546, Newington, CT 06131-7546.

Each CD and CD jewel case shall be labeled with the name of the project, State project number, name of the Contractor, date of submission, and name and address of the photographer.

Materials: Provide digital images in IBM-PC compatible JPEG format, with uncompressed (open) image size equal to or greater than the following dimensions: Pixel Dimensions = 1596 x 2000; Resolution = 200 pixels/inch. JPEG compression for each image shall equal "Quality 7" (High). Images shall be color (RGB mode).

Digital Cameras used for the purpose of creating the above noted image files shall have a minimum sensor size of 3.3 million pixels.

Image files shall be named and a photo thumbnail index created with the following file naming convention: *Project number date of submission photo number.jpg*

For example: If the first set of photos on CD for project number 0402-0002, is submitted on 12/13/01, the first photo of the submission shall be file named: 04020002_121301_1.jpg and the tenth photo of the set shall be file named: 04020002_121301_10.jpg. In the second set of photos on CD, submitted 1/12/02, the first photo of the set shall be file named: 04020002_011202_1.jpg

A hardcopy "Photo Thumbnail" index shall be provided with each CD submission. The photo thumbnails shall be printed on 8 ½" x 11" "glossy photo quality" ink jet paper with a minimum 720 dot-per-inch ink jet printer. The thumbnail images shall be a minimum 200 x 250 pixels at 200 pixel per inch resolution. The file names shall be located under each image. The thumbnail images shall be arranged so that they can all be contained on a single 8 ½-in by 11-in inkjet print. *For example*, 35 images would be arranged in five (5) columns and seven (7) rows. The CD shall also contain the digital file of the photo thumbnail index in jpeg format. The file shall share the same format as the above noted photo file format but the word "index" shall be placed in the location of the photo number. *For example*: 04020002_121301_index1.jpg

A hardcopy 8 ½" x 11" key plan with an arrow for each photograph taken shall be provided with each CD submission. Each arrow shall be labeled with the corresponding photograph number and shall be oriented to show the point of view of the photograph.

In lieu of using a digital camera to provide the above noted image files, standard 35 mm cameras and 35 mm color negative film may be used to take the images, and the images may then be captured as a digital file through the use of a designated 35mm film scanner. The 35mm scanner must have the following minimum specifications: 2700 dot per inch optical resolution; 3.4 Dmax; 36 bit color depth. The use of flatbed scanners shall not be permitted for this purpose.

Project progress photos shall be submitted as digital files on write-once CD-ROM in a jewel case on a monthly basis. **All subsequent CD submissions shall include the image files of the previous submissions and an updated hardcopy of the photo thumbnail index that contains all current and previous photos.**

Construction Methods: Where used herein, one set of photographs will be defined as Thirty Five (35) photographs.

Before starting construction, take one set of color photographs of the site and surrounding properties from different points of view as selected by the Engineer. Take photographs to show existing conditions to the property before starting Work. Take photographs of existing buildings either on or adjoining the property in sufficient detail to record accurately the physical conditions at the start of construction.

Take one set of color photographs at no greater than monthly intervals, coinciding as closely as possible with the completion of a major construction phase. The photographer shall select the vantage points for each shot each month to best show the status of construction and progress since the last photographs were taken. Prior to taking any photographs, review the proposed vantage points for each shot 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.

Take one set of color photographs upon notification by the Engineer of Final Inspection of the Project. Prior to taking any photographs, review the proposed vantage points for each shot with

the Engineer. Take photographs from opposing views of the site in an effort to display various characteristics of the new construction.

Method of Measurement: This work will be measured for payment by the number of photographic sets submitted to the Engineer. “Each” photographic set shall be defined as Thirty Five (35) photographs. For purposes of bidding, the pay unit for a photographic set shall be “Each.”

Basis of Payment: This work will be paid for at the Contract unit price each for “Progress Photographs” which price shall include all material, equipment, and labor incidental thereto. Where any submission’s image files do not conform to the requirements herein, the Contractor shall not receive any payment for the item.

<u>Pay Item</u>	<u>Pay Unit</u>
Progress Photographs	ea.

ITEM #0912530A - REMOVE AND RELOCATE BOLLARD

Description:

Work under this item shall consist of removing, storing and resetting of an existing decorative bollard on the raised island, at the location shown on the plans or as directed by the Engineer in conformance with these specifications. This work shall also include the relocation of the existing conduit and electrical components associated with the bollard so that the bollard functions as intended.

Construction Methods:

The existing decorative bollard and concrete foundation shall be carefully removed and stored. If the bollard is damaged during removal, the Contractor shall be responsible for replacing it. The bollard shall be set on a concrete base that is equivalent to the existing concrete base that is to be removed. The top of the concrete base shall be set at an elevation that allows for the installation of the brick pavers and level sand so that the brick paver at the base of the bollard are flush with the adjacent brick pavers. The bollard shall be fastened to the concrete base using anchor bolt or means equivalent to the current installation. The bollard shall be installed to ¼-inch overall tolerance and shall be set plumb and level above the finished surface. Bollard items that fall outside of this ¼-inch tolerance shall be reset to meet tolerance, as a condition of acceptance.

The existing conduit and electrical components associated with the bollard shall be relocated to the new bollard location and all electrical connections shall be reestablished.

Protect the stored bollard unit from damage, use, theft or vandalism, until acceptance. Contractor shall adjust, repair, or replace damaged, missing, or unacceptable items at their own expense. The bollard shall be cleaned with non-abrasive means, careful not to damage finishes.

Method of Measurement:

This work will be measured for payment by the actual number of bollards that are removed and relocated complete and accepted.

Basis of Payment:

This work will be paid for at the contract unit price per each bollard complete and accepted in place which price shall include removing, storing and reinstallation of the bollard, relocation of the electrical conduit and components and all material, labor, equipment and work incidental thereto.

ITEM #0913984A - TEMPORARY PROTECTIVE FENCE

Description: Work under this item shall consist of furnishing and installing temporary 8' high chain link fence, including gates, of the type and size as indicated on the Plans, and at the locations shown on the Plans or as ordered by the Engineer. Also included in this item is the resetting, as indicated or as directed by the Engineer, of the temporary chain link fence and gates, and the final removal and disposal following the completion of construction.

The temporary chain link fence shall be installed around the perimeter of the site, and staging areas, as shown on the Plans or as ordered by the Engineer. It shall be used to separate the Contractor's work areas from that of the surrounding public. As well as restricting access to Amtrak's right-of-way.

Materials: The material for the temporary chain link fence and gates, including all hardware and appurtenances, shall conform to the requirements of Article 9.13.02, except that polyvinyl chloride-coated fabric, posts and/or hardware will not be allowed. Temporary gates shall be of the same type of materials used for the adjacent chain link fence. The materials shall include all necessary hardware for swing-type operation.

The materials used shall be new or in good condition, if previously used. Previously used materials require the approval of the Engineer prior to installation.

Concrete for anchorages shall be Class PCC03340 and shall meet the requirements of Article M.03.01.

Construction Methods: Temporary chain link fence and gates shall be installed in accordance with the Plans and Section 9.13.03 of the specifications.

The Contractor shall maintain the fencing in good condition during the construction phase and shall immediately repair any damaged sections. Any temporary chain link fence and/or gates damaged by the Contractor, either during normal construction operations or the resetting process, shall be replaced at the Contractor's expense and at no cost to the State.

The Contractor shall remove the temporary fencing, including concrete anchorages if used, when no longer required for the work, as directed by the Engineer. The Contractor shall backfill all holes with granular material.

Method of Measurement: "Temporary Protective Fence" will be measured for payment by the number of linear feet of temporary fence installed and accepted, measured from outside to outside of terminal posts, as shown on the Plans or as ordered by the Engineer.

Temporary chain link gates, within the line of the temporary chain link fence will be considered part of the temporary chain link fence and measured for payment by the linear foot as noted above.

The resetting of the temporary protective fence for the Contractor to complete the work shown on the plans, to facilitate his needs, or the installation of additional temporary protective fence or gates for the Contractor's convenience will not be measured for payment.

Basis of Payment: This work will be paid for at the contract unit price per linear foot for "Temporary Protective Fence", which price shall include excavation, backfill, fabrication, concrete, disposal of surplus material, resetting, final removal and all materials, equipment, tools, and labor incidental to installing, maintaining, resetting where required and removal.

Pay Item	Pay Unit
Temporary Protective Fence	l.f.

ITEM #0915000A - TREE PROTECTION

Description:

Work under this item shall consist of the protection of selected trees, shrubs, and other woody plants by placing a temporary fence around them, as shown on the plans and in conformance with these specifications.

Materials:

The materials for tree protection will include:

1. Mesh construction fencing (orange)
2. Cedar posts (2-inch X 6-foot)
3. Mulch
4. #14 gauge steel wire or nylon locking ties for securing fence to posts
5. Temporary sign: white or yellow weatherproof material, with 3" black letter height that states "Keep Out, Tree Protection Area."

Construction Methods:

Temporary Fencing: Install temporary fencing around the tree protection zones designated on the plans or where directed by the engineer to protect remaining vegetation from construction damage. Maintain temporary fence and remove when construction is complete. A temporary fence of at least 4 feet in height shall be installed around each tree to be protected and preserved. The tree protection shall be installed prior to the actual construction start and maintained for the duration of the project. Within this protection zone, construction materials shall not be stored, equipment operated and/or temporary storage buildings or work trailers placed. The temporary fencing shall be constructed of orange snow fencing securely fastened to fence posts spaced a maximum of 8 feet on center. Posts are 6 feet in length with 2 feet set into the ground and 4 feet extending above ground. The fencing shall be attached to the post with a minimum of four 4 nylon-locking ties evenly placed at each post.

Temporary Signs: Install temporary signs 50 feet apart, or two per protected tree, whichever is greater, on posts of temporary fencing. Maintain temporary signs and remove when construction is complete.

Root Zone Protection: During the entire construction period all reasonable efforts shall be made to protect from damage those trees and their root system designated to remain. Around the trees to be protected, the Contractor shall avoid excessive excavation or compaction and damage during the removal of trees and shrubs designated to be removed. All plant material designated to be saved, or outside of the limits of construction, shall be protected during subsequent construction work. Work under these items will include construction and maintenance of temporary fencing to protect the root zones of existing trees and other plantings, construction and maintenance of tree trunk protection.

Method of Measurement:

This work will be measured for payment as a lump sum.

Basis of Payment:

This work will be paid for at the contract lump sum price for "Tree Protection" complete and accepted, which price shall include all materials, removal of materials, and all equipment, tools, labor, and work incidental thereto.

ITEM #0921018A - BRICK PAVING

Description:

Work under this item shall consist of installation of brick pavers, at the locations shown on the plans or as directed by the Engineer in conformance with these specifications.

Materials:

Gravel for base shall conform to Article M.02.01 for granular fill. Leveling base material shall be sand conforming to Article M.02.07-Free-Draining Materials.

Brick pavers shall match those that currently exist in areas adjacent to the work area.

Construction Methods:

The brick pavers shall be installed according to the details included on the contract plans. The Contractor shall be responsible for replacing any damaged materials. The granular fill shall be placed within the curb limits in layers not over 6 inches deep and to such a depth that after compaction it shall be the required depth below the finished grade. The leveling base shall be screeded loose to a thickness of approximately 1 to 1.5 inches. The leveling shall be treated with a soil sterilizer, of a type to be approved by the Engineer, prior to the placement of the brick pavers. The exact thickness of the leveling base is to be determined at the job site.

Care shall be taken by the Contractor to insure the screeded leveling base is loose and undisturbed placement. Pavers are to be installed "Hand-tight" with care being taken not to disturb the leveling bed. Mason string lines shall be used to insure proper lines and grades. Pavers are to be vibrated into the leveling base with a vibratory plate capable of achieving a 3,500 to 5,000 pounds compaction force. Such vibratory compaction shall be accomplished on all pavers prior to the end of operations on each working day. Compaction of the bricks shall continue until finish grade, as directed by the Engineer, is achieved. All joints shall be filled after final compaction with the same material used for the leveling base.

Method of Measurement:

This work will be measured for payment by the actual number of square feet of complete and accepted brick pavers.

Basis of Payment:

This work will be paid for at the contract unit price per square foot for "Brick Paving" complete and accepted in place which price shall include installation of brick pavers, and all material, labor, equipment and work incidental thereto.

ITEM #0947003A - BUS PASSENGER SHELTER

Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

Bus passenger shelters shall be constructed in accordance with Article 9.47, supplemented as follows:

Article 9.47.02 – Materials: Delete Sub-Sections 1–4 and 6, and replace with the following:

The bus passenger shelter shall be the Model #4-1R 10'x5' Cantilever Standing Seam Roof Passenger/Smoking Shelter Open Front with standard bench, dark bronze anodized aluminum finish and light fixture as manufactured by Handi-Hut, Inc., 3 Grunwald St., Clifton, NJ 07013 (800) 603-6635. **This is a sole source item and no substitutions will be allowed.**

Spare Parts

The following spare parts shall be supplied by the Contractor no later than the date of Substantial Completion:

Safety Glazing Panels: Furnish two (2) additional safety glazing panels in standard size as indicated in the Contract Documents and approved Shop Drawings. Provide panels complete with aluminum sash frame that matches products that are installed and that are packaged with protective covering for storage and identified with labels describing content.

Benches: Furnish one (1) additional bench that match products installed and that are packaged with protective covering for storage and identified with labels describing content.

Article 9.47.03 – Construction Methods: Add the following:

The bus passenger shelters and free-standing with integral benches and shall be installed in strict conformance with the manufacturer's instructions and recommendations.

Special Warranties

Special Warranty: Manufacturer agrees to repair or replace shelters that fail in materials or workmanship for a period of five (5) years from the date of Substantial Completion.

Special Warranty on Sheet Metal Roofing Finishes: Manufacturer agrees to repair finish or replace sheet metal roofing that shows evidence of deterioration of factory-applied finishes for a period of 20 years from the date of Substantial Completion.

Special Warranty on Glass: Manufacturer agrees to replace glass units that deteriorate within a period of five (5) years from the date of Substantial Completion. Deterioration of glass is

defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning glass contrary to manufacturer's written instructions.

ITEM #0949432A - ROOT PRUNING

Description: This item shall consist of protecting and maintaining the existing trees and shrubs located within the limits indicated on the plans. Protection and maintenance work shall include Root Pruning.

Construction Methods:

1. General: All tree protection and maintenance work shall be performed in compliance with the National Arborist Association and the American National Standards Institute (ANSI) Publication: ANSI Z 133.1 "Safety Requirements for Pruning, Trimming, Repairing, Maintaining and Removing Trees, and for Cutting Brush."

The Contractor, the Department's representative, the Engineer, and the Landscape Designer shall meet on the site to discuss all aspects of tree protection and maintenance prior to the commencement of any work, including clearing and grubbing operations. This meeting will include the field inspection of the staked limit of grading to review the existing vegetation and to identify any field modifications to the work.

No excavated material or construction materials are to be stockpiled within the drip line of any tree. Tree root systems shall be protected from smothering, flooding, erosion, and excessive wetting resulting from dewatering operations; and from run-off, spillage, and drainage of solutions containing materials which would be deleterious to tree roots. Parking and vehicular traffic will not be permitted within the tree's drip lines. Foot traffic over tree roots shall be restricted to prevent excessive compaction of soil over root systems.

2. Root Pruning: The Contractor shall operate a trenching machine, vibratory knife, or rock saw along the outside limits of grading prior to clearing and grubbing operations. The activity involves clean cutting tree roots to minimize the construction activity shock to the affected trees. Unless otherwise instructed by the Engineer, root pruning shall be performed to a depth of 2.5 feet only in the vicinity of existing trees. When a trenching machine is used, the trench shall be immediately backfilled with soil removed or organic soil. This root pruning operation shall occur prior to protective fencing and clearing and grubbing.

Measurement: This work shall be measured by the actual number of linear feet of "Root Pruning" completed and accepted.

Payment: Payment for this work will be made at the contract unit price per linear foot for "Root Pruning" complete in place, which price shall include all materials, equipment, tools, and labor incidental thereto.

Pay Item
Root Pruning

Pay Unit
L .F.

ITEM #0969000A - PROJECT COORDINATOR

Section 1.05.08 of the Standard Specifications is hereby deleted and replaced with the following:

Description: Under this item the Contractor shall furnish the services of an administrative employee, entitled the Project Coordinator, for this project to coordinate and expedite all phases of the work required for the project and to ensure that the construction schedule is maintained.

The minimum lump sum bid for this item shall be equal to 0.5% of the Contractor's total bid. Failure of the Contractor to bid at least the minimum amount will result in the Department adjusting the Contractor's bid to include the minimum bid amount for this item.

The Project Coordinator shall be submitted for approval by name, in writing, with a resume of his qualifications, within seven (7) calendar days of the award of the Contract, but not later than the Preconstruction Meeting, and shall not be changed without prior written notice to the Department.

This resume must demonstrate the Project Coordinator is experienced and versatile in the preparation, interpretation and modification of Critical Path Method (CPM) construction schedules. This must include successful completion of at least three (3) construction projects of similar complexity, where he served in a lead scheduling capacity. If the Contractor does not have a person in their company that has these skills, then the Contractor shall engage the services of a Consultant, subject to the approval of the Engineer, for the scheduling work required. If a Consultant is engaged, they shall be present at the first meeting, along with the Project Contractor, prepared to discuss, in detail, the methods and techniques he proposes to use. Thereafter, the Project Coordinator or the Consultant responsible for updating the CPM Schedule shall attend all meetings between the Contractor, its Subcontractors, and any other meetings, which will affect the CPM schedule. The Contractor shall prepare CPM Schedules utilizing the latest version of Primavera Project Planner software as described more fully hereinafter.

If the Contract includes Article 1.20 the following requirement shall also apply:

The Project Coordinator shall have, in addition to the above noted requirements, a minimum of eight (8) years' experience related to commercial/industrial building construction as a Project Coordinator performing duties similar to those required herein.

The Project Coordinator shall have knowledge of all trades involved in the construction, including civil/site work, environmental work, concrete work, masonry work, steel work, wood work, electrical work, and mechanical work.

Other combinations of experience and education totaling ten (10) years in commercial building construction will be considered subject to the approval of the Engineer.

Computer Software and Printer: The Contractor shall provide the following equipment with all the required maintenance and repairs (to include labor and parts) throughout the Contract life. The Engineer reserves the right to expand or relax the specification to adapt to the software and hardware limitations and availability.

The Contractor shall provide the Engineer with a licensed copy registered in the Department's name of the latest versions of the software listed and maintain customer support services offered by the software producer for the duration of the project. The Contractor shall deliver to the Engineer all supporting documentation for the software and hardware including any instructions or manuals.

- A. **Software – Minimum Specification:** __The Contractor shall provide the Engineer with a licensed copy of the latest version of the Primavera Contractor – Deluxe Version scheduling software, registered in the Department's name, and maintain the Primavera customer support service contract over the duration of the project.
- B. **HP Officejet Pro K8600 Color Printer** – Minimum or equivalent (to be installed as a local printer on a computer provided under the Construction Field Office specification):

Paper – 11 in x17 in, 8.5 in x 11 in and duplex/double-side print

Resolution – 1200x1200 DPI

Print Drivers – Must support HP PCL6.

RAM – 32 MB RAM

Print speed – 10 ppm – color, 13 ppm - black

Printer cable – 6 ft (1.8 m)

The Contractor is responsible for service and repairs to all computer hardware. All repairs must be performed within 24 hours. If the repairs require more than a 24 hours then a replacement must be provided.

Construction Methods: The Project Coordinator shall attend all meetings between the Contractor and the Department, the Contractor and its Subcontractors, and any other meetings that affect the progress of the job. The Project Coordinator shall be knowledgeable of the status of all parts of the work throughout the length of the Contract.

The Contractor shall prepare a CPM Schedule in accordance with the pertinent provisions of "Section 1.03 - Award and Execution of Contract," "Section 1.05 - Control of the Work," and "Section 1.08 - Prosecution of Progress" of the Standard Specifications. The schedule shall incorporate the Sequence of Construction as outlined on the Plans and in the Specifications. All other limiting factors that affect construction shall also be incorporated into the schedule. All milestones or constrained dates within the schedule shall be clearly indicated.

The CPM schedule shall contain a list of activities that represent the major elements of the project. At a minimum, this list should include a breakdown by individual structure or stage, including major components of each. The schedule shall contain sufficient detail to describe the progression of the work in a comprehensive manner. As a guide, 10 to 15 activities should be provided for each \$1 million of contract value.

The following list of items is provided as an example only and is not meant to be all-inclusive (or all-applicable):

General Items Applicable to all projects

Contractual Constraints including but not limited to

- Winter shutdowns
- Environmental permits/applications time of year restrictions
- Milestones
- Third Party approvals
- Long lead time items (procurement and fabrication of major elements)
- Adjacent Projects or work by others

Award

Notice to Proceed

Signing (Construction, temporary, permanent by location)

Mobilization

Permits as required

Field Office

Utility Relocations

Submittals/shop drawings/working drawings/product data

Construction of Waste Stockpile Area

Clearing and Grubbing

Earthwork (Borrow, earth excavation, rock excavation, etc.)

Traffic control items (including illumination and signalization)

Pavement markings

Drainage (Breakdown into components)

Culverts

Final Plantings (including turf establishment)

Final Cleanup

The following additional guidelines supplement the general guidelines listed above for the specific project types indicated:

A. For platforms, stair towers, walls and other structures, include major components such as:

Temporary Earth Retention Systems

Structure Excavation

Piles/test piles

Temporary Structures

Bearing Pads

Structural Steel (Breakdown by fabrication, delivery, installation, painting etc.)

- B. Multiple location projects shall be broken down first by location and then by operation.
- C. Facility Projects shall reflect the same breakdown of the project as the schedule of values:

- CSI Division 3 – Concrete
- CSI Division 4 – Masonry
- CSI Division 5 – Metals
- CSI Division 6 – Wood, Plastic, and Composites
- CSI Division 7 – Thermal and Moisture Protection
- CSI Division 8 – Openings
- CSI Division 9 – Finishes
- CSI Division 10 – Specialties
- CSI Division 12 – Furnishings
- CSI Division 14 – Conveying Equipment
- CSI Division 22 – Plumbing
- CSI Division 23 – Heating, Ventilating, and Air Conditioning
- CSI Division 26 – Electrical
- CSI Division 27 – Communications
- CSI Division 28 – Electronic Safety and Security

The CPM schedule will be compiled using this list of major activities. It will be the responsibility of the contractor to detail all milestones, environmental permit “window” periods; winter shutdowns etc. and include them on their schedule under the corresponding dates.

Proper relationship between all major activities shall be indicated. Node numbers shall be coded such that the major activities shown on the Critical Path Schedule shall be easily referenced to the Detailed Project Schedule when it is developed. Break down the work covered under each Special Provision, or Division and Section of Article 1.20 of the Standard Specifications, into individual activities required and logically group related activities together within the CPM.

If the Engineer determines that additional detail is necessary, the Contractor shall provide it.

All documents, which require approval by the Department, shall be clearly identified within the schedule. The Department and any outside agency shall be allocated a minimum number of calendar days in accordance with Article 1.20-1.05.02. If Article 1.20 does not apply, then the Department shall be allocated a minimum of thirty (30) calendar days (exclusive of weekends and holidays) for review and approval of each submittal. Any submittals requiring approval by an outside Agency (ConnDEEP, Coast Guard, Army Corps of Engineers, etc.) shall be allocated a minimum of sixty (60) calendar days. The Department shall not be held responsible for any delay associated with the approval or rejection of any substitution or other revisions proposed by the Contractor.

The schedule shall indicate the logic of the work for the major elements and components of work under the Contract, such as the planned mobilization of plant and equipment, sequences of operations, procurement of materials and equipment, duration of activities, type of relationship, lag time (if any), and such other information as it is necessary to present a clear statement of the intended activities.

The Contractor is responsible to inform its subcontractor(s) and supplier(s) of the project schedule and any relevant updates.

The schedules shall consist of a network technique of planning, scheduling and control, shall be a clear statement of the logical sequence of work to be done, and shall be prepared in such a manner that the Contractor's work sequence shall be optimized between early start and late start restraints. The Contractor shall use the same criteria in a consistent manner throughout the term of the project. If, at any time, the Contractor alters logic, original durations, and descriptions, adds activities or activity codes or in any way modifies the Baseline Schedule, they must notify the Engineer of the change, in writing, presenting in detail the reasons for the change. The Engineer reserves the right to approve or reject any such change.

The critical path of the project must be identified on the CPM schedule. The critical path is the longest-duration path through the network. The significance of the critical path is that the activities that lie on it cannot be delayed without delaying the project. Because of its impact on the entire project, critical path analysis is an important aspect of project planning.

The critical path can be identified by determining the following four parameters for each activity:

- ES - earliest start time: the earliest time at which the activity can start given that its precedent activities must be completed first.
- EF - earliest finish time, equal to the earliest start time for the activity plus the time required to complete the activity.
- LF - latest finish time: the latest time at which the activity can be completed without delaying the project.
- LS - latest start time, equal to the latest finish time minus the time required to complete the activity.

The *float time* for an activity is the time between its earliest and latest start time, or between its earliest and latest finish time. Float is the amount of time that an activity can be delayed past its earliest start or earliest finish without delaying the project. Delays to activities on the critical path through the project network in which no float exists, that is, where $ES=LS$ and $EF=LF$ will delay the project.

Float available in the schedule, at any time shall not be considered for the exclusive use of either the State or the Contractor. During the course of contract execution, any float generated due to the efficiencies of either party is not for the sole use of the party generating the float;

rather it is a shared commodity to be reasonably used by either party. Project float will be a resource available to both the State and the Contractor.

Each CPM Schedule submittal shall be in the form of an activity on node diagram (precedence diagramming method) and shall include at a minimum; an Early Start computer sort, a Total Float computer sort, an Activity Number computer sort, a Schedule Diagram in the Time Scaled Logic format and a backup data CD-ROM which includes all Primavera project files. The diagrams shall be on 2' x 3' sheets. Additional, more detailed diagrams for important aspects or phases of the work will be required on large or complex projects.

Activity I.D. numbers shall be keyed to the item numbers assigned on the detailed estimate sheet. The first three digits (four digits for highway illumination, signing, traffic signals and utility work) of the activity I.D. number shall be identical to the first three digits of the item number in the contract. The remaining digits may be used to provide unique, orderly and sequential I.D. numbers for each activity.

Activity codes shall be added to the schedule dictionary at the direction of the Engineer. At a minimum, activity codes for responsibility (prime, subcontractor by name), location of work (bridge #, span #, sta. #, site, building, type of work, etc.) and stage or phase number should be included.

The Project Coordinator shall be required to prepare and submit the following documents:

1. Baseline Submittal Requirements: The Contractor shall be guided by the following requirements when submitting the CPM Schedules for review and approval.
 - a. Within ten (10) calendar days after award, the Contractor and their scheduler will attend a meeting to discuss the submittal requirements. Within twenty (20) calendar days after contract award, the Contractor shall prepare and submit for review and approval a detailed CPM Schedule for all work. The review and approval process may take up to 21 calendar days and is more fully described in paragraph (b) of this section.

The work shall be broken out into sufficient detail such that no activity has a duration greater than twenty (20) days, unless approved by the Engineer. As a guide, 25 to 35 activities should be provided per \$1 million of contract work. The Engineer shall be the sole judge as to whether the schedule is sufficiently detailed.

All work shall be shown in sufficient detail such that the Critical Path may be identified and the schedule shall incorporate all contract milestones. Upon approval, this schedule shall be designated the "Baseline".

Failure to submit and gain approval for the "Baseline" may result in the Contractor being found in violation of Article 1.02.02 of the Standard Specifications. All elapsed contract time prior to the approval of the "Baseline", will be considered to be accurately

represented by the actual as-built schedule of that time period. No claims for delays during that period will be allowed.

The approval of a Baseline Schedule shall in no way waive the requirements of the contract nor shall it excuse the Contractor from any obligations under the contract.

In no instance will the Contractor be permitted to commence work on any significant portion of the work for which a Baseline Schedule has not been approved without prior written approval from the Department.

- b. The Contractor, represented by the Project Coordinator and/or the Consultant, shall participate with the Engineer in the review and evaluation of each schedule submitted. Any and all revisions made necessary as a result of this review shall be made by the Contractor and a revised schedule submitted within ten (10) calendar days. Any further revisions required thereafter shall also be submitted for approval within (10) calendar days.
2. Monthly Updates: Each month, as of a calendar date mutually acceptable to the Contractor and to the Engineer, the Contractor shall deliver to the Engineer three (3) prints of all required schedule diagrams and tabulations. In addition, the Contractor shall deliver one (1) copy of the project backup data CD-ROM(s), which includes all Primavera project files. The schedule shall be updated to show the work actually accomplished during the preceding months, the actual time consumed for each activity, and the estimated time remaining for any activity which has been started but not completed.

The monthly update shall also include revisions to the CPM schedule necessitated by revisions to the project, which have been directed by the Engineer (including, but not limited to extra work) during the month preceding the update. Similarly, any changes to the schedule due to Contractor influences shall also be included within the schedule.

Any changes or revisions made to the approved Baseline shall be identified in narrative form in a cover letter accompanying the monthly update. The Engineer reserves the right to approve or reject any such changes. The narrative shall also describe in general terms the progress of the work since the last schedule update and shall identify any items of special interest. If the schedule revisions extend the Contract completion date, due to extra or added work or delays beyond the control of the Contractor, the Contractor must submit a request in writing for an extension of time in accordance with Article 1.08.08. This request should be supported by the schedules submitted previously.

The Contractor shall be responsible to develop mitigation measures for all delays, regardless of responsibility, and to identify all time and cost impacts to the work associated with those mitigation measures.

Except as otherwise authorized by the Engineer, monthly submissions received after the due date are considered late.

The reports required for each monthly update shall include all reports generated for approval of the CPM Schedule for that particular portion of the work. On larger or complex projects, the Engineer may require the schedule data sorted by an activity code to better reflect the progression of the work. Summary barcharts may also be required.

3. Biweekly Schedules: Each week, the Contractor shall be required to produce and submit to the Engineer a biweekly schedule showing all activities planned for the following two week period. This short term schedule may be handwritten; however a two week "look ahead" filter from the CPM Schedule is preferred. The biweekly schedule shall clearly indicate all work planned on a crew basis for the two week period.
4. Recovery Schedules: If, in the opinion of the Engineer, the updated schedule indicates that the Project has fallen behind schedule, or that a revision in sequence of operations may be necessary for any other reason, absent a justifiable time extension, the Contractor shall immediately institute all necessary steps to improve the Project's progress and shall submit such revised network diagrams, tabulations and operational plans, as may be deemed necessary by the Engineer, to demonstrate the manner in which an acceptable rate of progress will be regained.

Should the Contractor not demonstrate an ability to regain an acceptable rate of progress, the Engineer shall require the schedule to be resource loaded with the next monthly update. No additional compensation will be allowed for resource loading the schedule.

5. As-Built Schedules: Within thirty (30) days of completion of the project, including all corrective work, the Contractor shall submit an "As-Built Schedule" showing the actual progress of work. The Contractor shall submit three prints of this final CPM Schedule and one project backup data CD-ROM which include all Primavera project files for the Engineer's exclusive use.

If the contract includes Article 1.20 the following shall also apply:

6. Daily Construction Reports: The Project Coordinator shall assist the Engineer in the preparation of a daily construction report by ensuring that each of the Contractor's employees and subcontractors working on the Project Site on a given day signs the Engineer's sign-in sheet for that day; and by keeping and providing to the Engineer its own daily list of employees and subcontractors who worked on the Project Site on that day.

Method of Measurement: Within ten (10) calendar days of the award of the Contract, the Contractor shall submit to the Engineer for approval a breakdown of its lump sum bid price for this item detailing:

1. The development cost to prepare the Baseline Schedule in accordance with these specifications. Development costs shall not exceed 25% of the total cost of the item and shall include costs to furnish and install all specified hardware.

2. The cost to provide the services of the Project Coordinator, including costs to prepare and submit the Monthly Updates; furnish and submit any Recovery Schedules; furnish and submit Two Week Look Ahead Schedules and maintenance of and supplies for the specified hardware noted above. A per month cost will be derived by taking this cost divided by the number of Contract months remaining from the date of acceptance of the Baseline Schedule.
3. The cost of submission and certification of the As-Built Schedule in accordance with these specifications. The submission and certification costs shall be no less than 2% of the total cost of the item.
4. Substantiation showing that the costs submitted are reasonable based on the Contractor's lump sum bid.

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

1. Upon approval of the "Baseline" Schedule by the Engineer, the lump sum development cost will be certified for payment.
2. Upon receipt of each monthly update of the "Baseline" Schedule, the per month cost for the services of the Project Coordinator will be certified for payment.
3. Upon approval of the As-Built Schedule by the Engineer, the lump sum submission and certification cost will be certified for payment.

Basis of Payment: This service will be paid for at the contract lump sum price for "Project Coordinator" complete, which price shall include the preparation and submission of all schedules, updates, reports and submittals. The lump sum price shall also include the cost of providing a complete, licensed copy of the Primavera software which will remain the property of the Engineer, and all materials, equipment, labor and work incidental of this service.

The lump sum price will be certified for payment as described in "Method of Measurement" subject to the following conditions:

1. Any month where the monthly update of the "Baseline" CPM schedule is submitted late, without authorization from the Engineer, will result in the following actions:
 - a. The monthly payment for the Project Coordinator item shall be deferred to the next monthly payment estimate. If any monthly submittal is more than thirty (30) calendar days late, there will be no monthly payment for the services of the Project Coordinator.

- b. The greater of 5% of the monthly payment estimate or \$25,000 shall be retained from the monthly payment estimate until such time as the Contractor submits all required reports.
 - c. If in the opinion of the Engineer, the contractor is not in compliance with this specification, the Engineer may withhold all project payments.
2. In the event the project extends beyond the original completion date by more than thirty (30) calendar days, and a time extension is granted to the Contractor, the Department may require additional CPM updates which will be paid at the per month cost for the services of the Project Coordinator.
 3. If, in the opinion of the Engineer, the contractor is not in compliance with this specification or has failed to submit a "Baseline", monthly update or Recovery Schedule for any portion of the work in accordance with this specification, it shall result in the withholding of all contract payments until the schedule is submitted to, and approved by, the Engineer.

<u>Pay Item</u>	<u>Pay Unit</u>
Project Coordinator	L.S.

ITEM #0969050A - DOCUMENT CONTROL SPECIALIST

Description: Under this item the Contractor shall furnish the services of an administrative employee, entitled Document Control Specialist who will ensure that the Contractor and all other parties as designated by the Engineer will prepare, status, electronically file and send all project correspondence and drawings utilizing a document control system as established and maintained by the Department. The primary function of the document control system is to ensure timely processing of all contract documentation in coordination with the project schedule. This document control system will also provide uniform project information and reporting. The Document Control Specialist shall be designated by name, in writing with a resume of their qualifications, within five (5) calendar days of the award of the Contract and shall not be changed without prior written notice to the Department.

The Document Control Specialist shall be knowledgeable of the status of all contract documentation aspects of the work throughout the length of the Contract. The Contractor shall prepare and maintain the contract documentation utilizing the SharePoint document control system. The document control system will be physically located in a secure location designated by the Department. The Contractor will directly access the document control system via the internet. The Department will provide the Contractor access to the SharePoint Document Control System. All references to the use of SharePoint shall refer to the Engineer's shared document control system as described above. All information that resides on the shared document control system shall become the sole property of the Engineer.

The minimum lump sum bid for this item shall be equal to 0.25% of the Contractor's total bid. Failure of the Contractor to bid at least the minimum amount will result in the Department adjusting the Contractor's bid to include the minimum bid amount for this item.

Documentation Requirements: All correspondence for the project shall be submitted and controlled using SharePoint, including, but not limited to: transmittals, meeting minutes, requests for information (RFI's), requests for change (RFC's), submittals, field memos, notices, letters, and punch lists. All common correspondence files (submittals, requests, answers, changes, reports, minutes, agendas, letters, etc.) shall be stored within the common file server, including any and all file attachments. Submittals, including shop drawings, working drawings, catalog cuts, material certifications, and all documentation required by contract, shall be submitted electronically via SharePoint. Original hardcopy documents may still be required as determined by the Engineer. The Contractor is responsible to coordinate the overall creation and submission of all project documentation to meet the requirements of the project schedule and Technical Specifications.

The named Document Control Specialist shall be designated as the Submittal Coordinator and will be responsible for maintaining information related to the responsibility, status, elapsed time since submission, held time, start/finish times, and a history of all submittal revisions. A submittal log must be maintained to indicate the latest construction submittals sent and received and the distribution of these drawings to the Department. Each submittal (shop drawing,

working drawing, product data, samples, etc) must be individually entered, tracked, and the status maintained, including all revisions. The Contractor is responsible to utilize the latest drawings marked “Conforms” or “Conforms as Noted” as identified in the control system. All revisions are to be logged into the control system, describing each change.

All meeting minutes shall be uploaded into the control system. The Contractor is responsible to utilize meeting minutes and respond (electronically) to meeting minute items assigned to the Contractor.

Documents (letters, logs, shop or working drawings, sketches, payrolls, etc) to be transmitted to the Department by the Contractor, for which the Contractor does not have an electronic version, shall be scanned, converted into an Adobe Acrobat PDF format, and attached accordingly in SharePoint.

The document control system shall be available for Contractor use at all times unless system maintenance (i.e. backups, upgrades, etc) is being performed. System maintenance will generally be limited to 10 PM – 6AM, Monday - Friday and at various times on weekends. In the event a Contractor’s authorized user cannot access the control system, the Contractor shall notify the Department’s control system representative. In the event the control system becomes unavailable during normal business hours for an extended period of time, the Contractor may issue correspondence requiring immediate attention by the Department in hard copy format. The hard copy correspondence must be entered into the control system immediately upon becoming available again. Inability by the Contractor to gain access to the document control system for any reason shall not be grounds for claim. The use of the database is not required for proprietary cost and contract information.

The Department shall be allocated a minimum of ten (10) calendar days (using a 7-day calendar, exclusive of holidays) for review and response to each RFI submitted. RFI’s requiring information from outside agencies shall be allocated twenty-one (21) days (using a 7-day calendar, exclusive of holidays).

The Department shall be allocated a minimum of thirty (30) calendar days (using a 7-day calendar, exclusive of holidays) for review and response to each RFC submitted. RFC’s requiring information from outside agencies shall be allocated sixty (60) days (using a 7-day calendar, exclusive of holidays).

The Department reserves the right to reject any RFC submitted in the form of an RFI for the purpose of reducing the Department’s review and response time. Such documents will not be considered for review by the Department and will be returned to the Contractor for resubmission. Review and response time for such document will commence upon resubmission in the correct format.

The Department shall be allocated a minimum of twenty-one (21) calendar days (using a 7-day calendar, exclusive of holidays) for review and approval of each submittal, unless specified otherwise within the contract documents. Any submittals requiring approval by an outside Agency shall be allocated a minimum of sixty (60) calendar days (using a 7-day calendar, exclusive of holidays). A schedule of submittals shall be submitted to The Department for

review prior to the start of construction. These durations are a MINIMUM and will likely increase with the number of outstanding submittals in The Department's possession. Therefore, whenever multiple Contractor submittals are under review by the Department, the Contractor shall prioritize the submittals and notify the Department thereof. The submittal schedule must be submitted early for review as a subset of the baseline schedule. The Department shall not be held responsible for any delay associated with the approval or rejection of any substitution or other revisions proposed by the Contractor.

Submittals

Submittal and review activities are required in the Project Schedule per Item No. 0969000A, Project Coordinator. Submittal activities must be coordinated between the Project Coordinator and Document Control Specialist such that submittal information common to both the project schedule and the document control system (required and actual dates, sequence of submission, resubmissions if required) correspond with one another. All resubmissions shall be numbered with the original submittal number but designated a new revision number. All resubmissions shall be logged into the control system to properly calculate the entire duration required for the submittal process from the original submission date to final approval to indicate total days to process the submittal through all review cycles. Coordination of submittals is required for same work and interfacing work so that one submittal will not delay another.

Refer to the following Notices to Contractor for additional submittal requirements:

- Submittals
- Early Submittals
- FM Global Submittals
- Closeout Documents

Submittal numbering, naming conventions, etc. shall be in accordance with the project-specific SharePoint site. Training on the use of the SharePoint site shall be provided as described below.

The Contractor shall examine and check each submittal for accuracy, completeness, coordination with related submittals and compliance with the Contract before it is transmitted to the Designer for review. The Contractor shall sign and submit the Submittal Register Form (sample attached to this section) with each submittal which includes the following statement: "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." By reviewing and certifying each submittal, the Contractor represents that he has determined and verified materials, field measurements and field construction criteria related thereto, and has checked and coordinated information contained within such submittals with requirements of the Work and the Contract. Shop drawings submitted without this signed statement will be rejected immediately and returned to the Contractor.

Shop drawings, working drawings and submittal attachments shall be submitted in Adobe Acrobat PDF format.

Submittal of samples for review and approval by the Designer shall be submitted using a SharePoint-generated transmittal. The Contractor shall ship the quantity of physical samples required by the contract to the Designer with the hard copy of the transmittal. The Designer shall generate the return transmittal in SharePoint (indicating the sample's review status as to Conforms, Conforms as Noted, Revise and Resubmit, Rejected, or No Action Required) and transmit it to the Contractor. The Designer shall retain one set of samples marked "Conforms" or "Conforms as Noted", transmit one set of same to the Engineer, and transmit the remaining sets of same to the Contractor.

Submittals requiring a signature by a licensed engineer or other party shall be digitally signed utilizing a digital ID obtained from an Adobe partner Certified Document Service (CDS) provider (see adobe.com for the list of CDS providers).

Required Start & Expected Finish shall represent the date range for the review process. Required Start shall be the date the submittal is issued by the Contractor for review. Expected Finish shall be the completion date for the review cycle (either 21 or 60 days later, as appropriate).

Two (2) sets of hard copies of all submittals marked "Conforms" or "Conforms as Noted" shall be transmitted, by the Contractor, to the Engineer within five (5) working days. The Contractor shall submit hard copies of all letters signed in ink with any attachments to the addressee (original) and the ConnDOT District Office (copies) for their records. Scans of signed letters and their attachments shall be stored in SharePoint by the Contractor. The Contractor shall submit wet stamped hard copies of all conformed shop drawings requiring the signature of a professional engineer (eg, steel bar joists, etc.) to the Department for their records. Scanned copies of these conformed shop submittals or other electronic copies will be stored by the Contractor in SharePoint. The Contractor shall submit hard copies and electronic copies of Maintenance Manuals and Warranties.

Submittal Schedules

In order to facilitate the Department's review of the large number of submittals anticipated for this project, the Contractor is to provide a submittal schedule in accordance with Form 817 Section 1.20-1.05.02, Subsection 3, and as described herein. The submittal schedule will be maintained in SharePoint and shall meet the following requirements:

A submittal schedule must be created for each contract item, including those under the contract Major Lump Sum Item(s), requiring a submittal. At a minimum, the submittal schedule shall include a Contract Item Number, Title, Status, Required Start, and Required Finish, where the Status is "Unsubmitted" for those items not yet submitted, and the Required Start and Required Finish represents the review period as described above. The Required Start and Required Finish dates must be coordinated with the project CPM schedule.

Additionally, the Contractor shall prepare and distribute a 60 day "Look Ahead Submittal Schedule", to be updated accordingly and presented and discussed at the scheduled project coordination meetings as part of the standing meeting agenda. The Look Ahead Submittal Schedule will be based on the CPM schedule (without limitation on early submittals), and will provide the following in matrix/spreadsheet format:

- Contract Item No. (Note - for the MLSI, provide CSI Division No. & Specification Section No.)
- Contractor's best estimate to identify the actual submittals to be made for those Contract Items or specification sections with multiple submittals
- Contractor's best estimate of a target date the identified submittals will be made
- Identification of planned "Hot Submittals" needed to support near-term construction activities
- Identification of planned "Major Submittals" which are anticipated to require significant review effort (e.g., coordination drawings)

The Contractor shall also generate and distribute a submittal log to be presented and discussed at the scheduled project coordination meetings as part of the standing meeting agenda. The submittal log will show all submittals currently under review and the status of each. The submittal log will be able to be generated from the SharePoint site from the current status of the submittals in the system.

Documentation Control System Access Requirements: Within five (5) days of Contract Award, the Contractor shall designate, in writing, up to five (5) named Contractor personnel, to be approved and authorized by the Engineer to access the document control system. The Contractor shall designate one (1) of the five (5) authorized personnel to be the Document Control Specialist and act as the document control system contact person for the Contractor. All Contractor personnel requesting access authorization must complete the minimum training requirements described below and submit a certificate of completion to the Department. Upon receipt of the request (with training certificate(s)) and approval thereof, the Department will issue a username and password to each of the authorized Contractor personnel. The Contractor will ensure that only authorized Contractor personnel access and utilize the control system in a responsible, non-destructive manner. The Contractor shall make every reasonable effort to prevent the disclosure of access information for unauthorized use of the control system. The Department, at its discretion, may revoke access authorization from any user if it is determined that the user: a) has used the control system for any other reason than is intended by this specification; b) is no longer in the Contractor's employ or associated with the project or c) has disclosed their access authorization for use by another person or party for any reason. The Contractor is responsible to ensure their authorized users have access to the public internet from a computer system running any currently supported Microsoft Windows Operating System and Microsoft Internet Explorer Web Browser with a minimum Cipher Strength of 128 bit, and is supported by Microsoft SharePoint 2010. Browsers supported by Microsoft SharePoint 2010 can be found here: <http://technet.microsoft.com/en-us/library/cc263526%28v=office.14%29.aspx>. Minimum modem speed shall be 768K (business DSL). The Contractor is responsible to ensure that anti-virus software is installed and maintained on any computer accessing the Department's document control system. Additionally, it is the Contractor's sole responsibility to maintain a compatible software system. Compatibility is defined as the ability to send and receive documents in a format viewable by the Department. The Contractor must provide valid individual email addresses for each authorized user to the Department based upon a MAPI compliant email system, such as Microsoft Outlook or Exchange.

Training Requirements: Contractor personnel accessing the document control system must fulfill minimum training requirements. Personnel must attend a two (2) day project specific SharePoint training class provided by the Department. Training requests are to be made through the Engineer. The Department will provide the training facility and will supply all hardware, software, etc. required for the class. The costs of all Contractor personnel's training time are the responsibility of the Contractor.

Any additional training required, as a result of adding additional or replacing existing Contractor staff, shall be included in the total cost of this item.

Submittals: Within thirty (30) calendar days after award, the Submittal Coordinator shall prepare, in accordance with all requirements of this specification, and submit for review and acceptance, a Submittal Schedule and shall have the following minimum requirements attached:

- Submittal Summary Report
- Submittal Bar Chart Report

Method of Measurement: Within ten (10) calendar days of the award of the Contract, the Contractor shall submit to the Engineer for approval a cost breakdown of his lump sum bid price. The submission must include substantiation showing that the costs breakdown submitted are reasonable based on the Contractor's lump sum bid. The cost breakdown shall be in accordance with the following payment schedule:

- 1) The cost to successfully complete all training to utilize the document control system, in accordance with these specifications, shall not exceed 5% of the total cost of the item.
- 2) The development cost to prepare the Submittal Forecast in accordance with these specifications shall not exceed 5% of the total cost of the item. Payment for this work will be made upon acceptance of the Submittal Forecast by the Engineer.
- 3) The cost to provide services of the Document Control Specialist, including costs to maintain the Submittal Forecast; Coordinating the Document Control System submittal information with the CPM Schedule submissions; preparing, submitting, utilizing, maintaining, coordinating and updating document control system items as required by all Contractor personnel with access rights to the system, shall be paid as a per month cost. This cost shall be derived taking the remaining item cost and dividing it by the number of contract months.

Basis of Payment: This service shall be paid for at the contract lump sum price for "Document Control Specialist" complete, which price shall include the Contractor personnel's training time, preparation, status, electronically scanning, filing, and sending all project correspondence, and the furnishing, maintenance, and supply costs for all services as noted above in the utilization of the document control system as established and maintained by the Department. The lump sum price will be certified for payment as described in "Method of Measurement" subject to the following conditions:

- 1) Failure by the Contractor to utilize and regularly update the specified SharePoint database in a manner acceptable to the Department or failure to utilize the common file server for the

storage of all project related files may result in the withholding of all contract payments until such time as all specification requirements have been satisfied. Failure by the designated Document Control Specialist to update submittal statuses on a regular basis shall result in the replacement of the Document Control Specialist at the Engineer's request. Additionally, the Contractor may be found in violation of Article 1.02.02 of the Standard Specifications "for having failed to prosecute work continuously, diligently and cooperatively in an orderly sequence".

- 2) In the event the project extends beyond the original completion date by more than thirty (30) calendar days, and a time extension is granted to the Contractor, the Department may require the continued utilization of the Document Control System which shall be paid at the per month cost for the services of the Document Control Specialist.

<u>Pay Item</u>	<u>Pay Unit</u>
Document Control Specialist	L.S.

SUBMITTAL REGISTER FORM

The use of this Submittal Register Form is required for all submittals

Project Name: NEW HAVEN-HARTFORD-SPRINGFIELD
HIGH SPEED RAIL PROGRAM
WINDSOR SHORT HIGH-LEVEL PLATFORM STATION
Windsor, CT
State Project No. 0320-0019
Connecticut Department of Transportation

Design Engineer:

Contractor: _____

Address: _____

Telephone No.: _____

Subcontractor: _____

Address: _____

Telephone No.: _____

Submittal Number: _____

Submittal Title: _____

Specification Section and Paragraph Number: _____

Contract Drawing and Detail Reference: _____

Date of Initial Submittal: _____

Date of this Submittal: _____

CPM Activity Number: _____

This Submittal Prepared By: _____

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.

By: _____
Signature

Printed or Typed Name

Title

Date

ITEM #0969062A - CONSTRUCTION FIELD OFFICE, MEDIUM

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	Med.
Minimum Sq. Ft. of floor space with a minimum ceiling height of 7 ft.	400
Minimum number of exterior entrances.	2
Minimum number of parking spaces.	7

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: 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. 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.

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 68°-80° Fahrenheit within the field office.

Telephone Service: The Contractor shall provide telephone service with unlimited nation-wide calling plan. 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. 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.

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. 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	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.	3
Standard secretarial type desk and matching desk chair that has pneumatic seat height adjustment and dual wheel casters on the base.	-
Personal computer tables (4 ft. x 2.5 ft.).	3
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
Conference table, 3 ft. x 12 ft.	-
Table – 3 ft. x 6 ft.	-
Office Chairs.	4

Mail slot bin – legal size.	-
Non-fire resistant cabinet.	-
Fire resistant cabinet (legal size/4 drawer), locking.	1
Storage racks to hold 3 ft. x 5 ft. display charts.	-
Vertical plan racks for 2 sets of 2 ft. x 3 ft. plans for each rack.	1
Double door supply cabinet with 4 shelves and a lock – 6 ft. x 4 ft.	-
Case of cardboard banker boxes (Min 10 boxes/case)	1
Open bookcase – 3 shelves – 3 ft. long.	-
White Dry-Erase Board, 36” x 48”min. with markers and eraser.	1
Interior partitions – 6 ft. x 6 ft., soundproof type, portable and freestanding.	-
Coat rack with 20 coat capacity.	-
Wastebaskets - 30 gal., including plastic waste bags.	1
Wastebaskets - 5 gal., including plastic waste bags.	3
Electric wall clock.	-
Telephone.	1
Full size stapler 20 (sheet capacity, with staples)	2
Desktop tape dispensers (with Tape)	2
8 Outlet Power Strip with Surge Protection	4
Rain Gauge	1
Business telephone system for three lines with ten handsets, intercom capability, and one speaker phone for conference table.	-
Mini refrigerator - 3.2 c.f. min.	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
Microwave, 1.2 c.f. , 1000W min.	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.	2
Electronic office type printing calculators capable of addition, subtraction, multiplication and division with memory and a supply of printing paper.	1
Small Multi-Function Laser Printer/Copier/Scanner/Fax combination unit, network capable, as specified below under <u>Computer Related Hardware and Software</u> .	1
Large Multi-Function Laser Printer/Copier/Scanner/Fax combination unit, network capable, as specified below under <u>Computer Related Hardware and Software</u> .	
Field Office Wi-Fi Connection as specified below under <u>Computer Related Hardware and Software</u>	1
Wi-Fi Printer as specified below under <u>Computer Related Hardware and Software</u> .	1
Digital Camera as specified below under <u>Computer Related Hardware and Software</u> .	1
Video Projector as specified below under <u>Computer Related Hardware and Software</u> .	-
Smart Board as specified below under <u>Computer Related Hardware and Software</u> .	-

Infrared Thermometer, including annual third party certified calibration, case, and cleaning wipes.	1
Concrete Curing Box as specified below under Concrete Testing Equipment.	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
Concrete Slump Cone and accessories as specified below under Concrete Testing Equipment.	1
First Aid Kit	1
Flip Phones as specified under <u>Computer Related Hardware and Software</u> .	-
Smart Phones as specified under <u>Computer Related Hardware and Software</u> .	-

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, Medium," 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, Medium	Month

ITEM #0980001A - CONSTRUCTION STAKING

[This is an alternate to CSI Section 017000, “Construction Staking”]

Description: Under this item, 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.

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.

Submit a record of Project work performed and project data as required under provisions of Form 817 Article 1.20-1.08.14.

Engage a Land Surveyor licensed in the State of Connecticut who is experienced in providing land-surveying services of the kind indicated.

Engage a Professional Engineer of the discipline required, licensed in the State of Connecticut, to perform engineering services of the kind indicated.

Materials:

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 Statutes, Section 20-300b.

Construction Methods:

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.

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.

The existing benchmarks, control points and property corners are shown on the plans.

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.

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.

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.

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.

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.

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.

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.

Method of Measurement: This item will be paid for at the contract lump sum price for “Construction Staking” complete.

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

PAY ITEM

PAY UNIT

Construction Staking

LS

ITEM #0992093A - RESET BRICK PAVING

Description:

Work under this item shall consist of removing, storing and resetting brick pavers on the raised island, at the location shown on the plans or as directed by the Engineer in conformance with these specifications.

Materials:

Gravel for base shall conform to Article M.02.01 for granular fill. Leveling base material shall be sand conforming to Article M.02.07-Free-Draining Materials.

Construction Methods:

Existing brick pavers shall be carefully removed and stored. If any pavers are broken during removal, the Contractor shall be responsible for replacing them. The brick pavers shall be installed according to the details included on the contract plans. Upon reconstruction of the raised island by resetting the concrete curbing, the granular fill shall be placed within the curb limits in layers not over 6 inches deep and to such a depth that after compaction it shall be the required depth below the finished grade of the raised island. The leveling base shall be screeded loose to a thickness of approximately 1 to 1.5 inches. The leveling shall be treated with a soil sterilizer, of a type to be approved by the Engineer, prior to the placement of the brick pavers. The exact thickness of the leveling base is to be determined at the job site.

Care shall be taken by the Contractor to insure the screeded leveling base is loose and undisturbed placement. Pavers are to be installed "Hand-tight" with care being taken not to disturb the leveling bed. Mason string lines shall be used to insure proper lines and grades. Pavers are to be vibrated into the leveling base with a vibratory plate capable of achieving a 3,500 to 5,000 pounds compaction force. Such vibratory compaction shall be accomplished on all pavers prior to the end of operations on each working day. Compaction of the bricks shall continue until finish grade, as directed by the Engineer, is achieved. All joints shall be filled after final compaction with the same material used for the leveling base.

Method of Measurement:

This work will be measured for payment by the actual number of square feet of complete and accepted brick pavers that have been removed and reset.

Basis of Payment:

This work will be paid for at the contract unit price per square foot for "Reset Brick Paving" complete and accepted in place which price shall include removing, storing and reconstruction of brick pavers, and all material, labor, equipment and work incidental thereto

ITEM #1302061A - ADJUST GATE BOX (WATER)

Description: Reference to the “District” in this item refers to “The Metropolitan District”.

The Contractor shall adjust to final grade, the gate boxes and covers appurtenant to the water mains as required and furnish and install extension rings, extension stems, air valve extensions, covers, and additional top or bottom sections if necessary, as shown on the Contract Drawings or as directed by the Engineer in accordance with these specifications.

Materials: The Contractor shall furnish standard District cast iron Dwyer type gate box sections as required and extension stems if necessary.

All additional materials, including any resurfacing materials and any additional fill required, shall be furnished and placed by the Contractor. Gravel shall conform to Article M.02.01.

Construction Methods: The Contractor shall carefully excavate around the gate boxes, remove the boxes, install extension stems if necessary, reinstall the present gate box if reusable, adjust the box to final grade using extension rings if applicable, and refill the excavation. Care shall be taken to prevent material from filling the inside of the gate box.

Extension stems will be required if the gate box is raised 24-inches or more. Extension stems shall be fabricated according to the detail W-21 of the District’s “Standard Details Manual.”

Any damage done to District facilities by the Contractor shall be repaired or replaced by the Contractor at his expense.

Method of Measurement: The number of adjust gate boxes, complete with extension stems, air valve extensions, gate box extension rings, covers, and additional top or bottom sections, if necessary, measured for payment shall be the actual number of each box reset.

Basis of Payment: This work will be paid for at the contract unit price for “Adjust Gate Box (Water)” complete in place, which price shall include the cost of furnishing material, including labor and equipment to incorporate them into the work. It shall also include the clearing, trenching and disposal of excavated materials, refilling trenches, furnishing the additional material for refilling, grading, sheeting, bracing, and pumping.

Pay Item	Pay Unit
ADJUST GATE BOX (WATER)	EA.

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.

Materials: 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 of Payment: This work will be paid as Extra Work.

Pay Item
Service Connections (Estimated Cost)

Pay Unit
Estimated Cost

Town: Windsor, Connecticut

INDEX OF CSI FORMATTED SPECIFICATIONS

Note: This index 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 index shall not be considered part of the contract.

DIVISION 1 and DIVISION 2 – GENERAL REQUIREMENTS

- 01141A Safety and Protection of Railroad Traffic and Property (AMTRAK)
- 01142A Submission Documentation Required For Amtrak Review and Approval of Plans for Bridge Erection, Demolition and Other Crane/ Hoisting Operations over Railroad Right-Of-Way (AMTRAK)
- 01520A Requirements for Temporary Protection Shields For Demolition and Construction of Overhead Bridges and Other Structures (AMTRAK)
- 02261A Requirements for Temporary Sheeting and Shoring to Support Amtrak Tracks (AMTRAK)
- 024119 Selective Demolition

DIVISION 3 – CONCRETE

- 033000 Cast-in-Place Concrete

DIVISION 4 – MASONRY

- 042113 Brick Masonry
- 042200 Concrete Unit Masonry
- 047200 Cast Stone Masonry

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- 051200 Structural Steel Framing
- 051213 Architecturally Exposed Structural Steel Framing
- 051300 Retractable Platform Edge
- 052100 Bearing Pads
- 054000 Cold-Formed Metal Framing
- 055000 Metal Fabrications
- 055210 Pipe and Tube Railings

Town: Windsor, Connecticut

DIVISION 6 – WOOD, PLASTICS AND COMPOSITES

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- 061600 Sheathing
- 066100 Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels
- 066400 Polyethylene Platform Edge Strips
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DIVISION 7 – THERMAL AND MOISTURE PROTECTION

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- 071900 Water Repellents
- 072100 Thermal Insulation
- 074113.13 Formed Metal Roof Panels
- 073200 Composite Roof Tile Systems
- 074293 Soffit Panels
- 074650 Exterior Siding and Trim
- 076200 Sheet Metal Flashing and Trim
- 077100 Roof Specialties
- 077253 Snow Guards
- 079200 Joint Sealants

DIVISION 8 – OPENINGS

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- 099113 Exterior Painting
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Town: Windsor, Connecticut

DIVISION 10 – SPECIALTIES

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- 260553 Identification for Electrical Systems

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END OF INDEX OF CSI FORMATTED SPECIFICATIONS

SECTION 01141A -SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY

PART 1 -GENERAL

1.1 SCOPE

- A. This specification describes the safety procedures and protection provisions for Contractors and Permittees entering and working upon railroad property.
- B. Use of this specification is as required by Amtrak, as described in Amtrak Engineering Practice EP3014.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 DEFINITIONS

- A. CHIEF ENGINEER: Amtrak Chief Engineer
- B. RAILROAD: National Railroad Passenger Corporation (Amtrak), and/or the duly authorized representative
- C. ENGINEERING PRACTICE: Amtrak Engineering Practices establish a system of uniform practices, notices and instructions for the Amtrak Engineering Department, providing current, permanent and temporary, departmental procedures and policies.

PART 2 -PRODUCTS (Not Used)

PART 3 -EXECUTION

3.1 PRE-ENTRY MEETING

- A. Before entry of Permittee and/or Contractors onto Railroad's property, a pre-entry meeting shall be held at which time Permittee and/or Contractors shall submit for written approval of the Chief Engineer, plans, computations and a detailed description of proposed methods for accomplishing the work, including methods for protecting Railroad's traffic. Any such written approval shall not relieve Permittee and/or Contractor of their complete responsibility for the adequacy and safety of their operations.

3.2 RULES, REGULATIONS AND REQUIREMENTS

- A. Railroad traffic shall be maintained at all times with safety and continuity, and Permittee and/or Contractors

shall conduct their operations in compliance with all rules, regulations, and requirements of Railroad (including these Specifications) with respect to any work performed on, over, under, within or adjacent to Railroad's property. Permittee and/or Contractors shall be responsible for acquainting themselves with such rules, regulations and requirements. Any violation of Railroads safety rules, regulations, or requirements shall be grounds for the immediate suspension of the Permittee and/or Contractor work, and the re-training of all personnel, at the Permittee's expense.

3.3 MAINTENANCE OF SAFE CONDITIONS

- A. If tracks or other property of Railroad are endangered during the work, Permittee and/or Contractor shall immediately take such steps as may be directed by Railroad to restore safe conditions, and upon failure of Permittee and/or Contractor to immediately carry out such direction, Railroad may take whatever steps are reasonably necessary to restore safe conditions. All costs and expenses of restoring safe conditions, and of repairing any damage to Railroad's trains, tracks, right-of-way or other property caused by the operations of Permittee and/or Contractors, shall be paid by Permittee.

3.4 PROTECTION IN GENERAL

- A. Permittee and/or Contractors shall consult with the Chief Engineer to determine the type and extent of protection required to insure safety and continuity of railroad traffic. Any Inspectors, Track Foremen, Track Watchmen, Flagman, Signalmen, Electric Traction Linemen, or other employees deemed necessary by Railroad, at its sole discretion, for protective services shall be obtained from Railroad by Permittee and/or Contractors. The cost of same shall be paid directly to Railroad by Penittee. The provision of such employees by Railroad, and any other precautionary measures taken by Railroad, shall not relieve Permittee and/or Contractors from their complete responsibility for the adequacy and safety oftheir operations.

3.5 PROTECTION FOR WORK NEAR ELECTRIFIED TRACK OR WIRE

- A. Whenever work is performed in the vicinity of electrified tracks and/or high voltage wires, particular care must be exercised, and Railroad's requirements regarding clearance to be maintained between equipment and tracks and/or energized wires, and otherwise regarding work in the vicinity of electrified tracks, must be strictly observed. No employees or equipment will be permitted to work near overhead wires, except when protected by a Class A employee of Railroad. **Permittee and/or Contractors must supply an adequate length of grounding cable (4/0 copper with approved clamps) for each piece of equipment working near or adjacent to any overhead wire.**

3.6 FOULING OF TRACK OR WIRE

- A. No work will be permitted within twenty-five (25) feet of the centerline of track or the energized wire or have potential of getting within twenty-five (25) feet of track wire without the approval of the Chief Engineer's representative. Permittee and/or Contractors shall conduct their work so that no part of any equipment or material shall foul an active track or overhead wire without the written permission of the Chief Engineer's representative. When Permittee and/or Contractors desire to foul an active track, they must provide the Chief Engineer's representative with their site-specific work plan a minimum of twenty-one (21) working days in advance, so that, if approved, arrangements may be made for proper protection of Railroad. Any equipment shall be considered to be fouling a track or overhead wire when located (a) within fifteen

(15) feet from the centerline of the track or within fifteen (15) feet from the wire, or (b) in such a position that failure of same, with or without a load, would bring it within fifteen (15) feet from the centerline of the track or within fifteen (15) feet from the wire and requires the presence of the proper Railroad protection personnel.

- B. If acceptable to the Chief Engineer' s representative, a safety barrier (approved temporary fence or barricade) may be installed at fifteen (15) feet from centerline of track or overhead wire to afford the Permittee and/or Contractor with a work area that is not considered fouling. Nevertheless, protection personnel may be required at the discretion of the Chief Engineer's representative.

3.7 TRACK OUTAGES

- A. Permittee and/or Contractors shall verify the time and schedule of track outages from Railroad before scheduling any of their work on, over, under, within, or adjacent to Railroad's right-of-way. Railroad does not guarantee the availability of any track outage at any particular time. Permittee and/or Contractors shall schedule all work to be performed in such a manner as not to interfere with Railroad operations. Permittee and/or Contractors shall use all necessary care and precaution to avoid accidents, delay or interference with Railroad's trains or other property.

3.8 DEMOLITION

- A. During any demolition, the Contractor must provide horizontal and vertical shields, designed by a Professional Engineer registered in the state in which the work takes place. These shields shall be designed in accordance with the Railroad's specifications and approved by the Railroad, so as to prevent any debris from falling onto the Railroad's right-of-way or other property. A grounded temporary vertical protective barrier must be provided if an existing vertical protective barrier is removed during demolition. In addition, if any openings are left in an existing bridge deck, a protective fence must be erected at both ends of the bridge to prohibit unauthorized persons from entering onto the bridge.
- B. Ballasted track structure shall be kept free of all construction and demolition debris. Geotextiles or canvas shall be placed over the track ties and ballast to keep the ballast clean.

3.9 EQUIPMENT CONDITION

- A. All equipment to be used in the vicinity of operating tracks shall be in "certified" first-class condition so as to prevent failures that might cause delay to trains or damage to Railroad's property. No equipment shall be placed or put into operation near or adjacent to operating tracks without first obtaining permission from the Chief Engineer's representative. **Under no circumstances shall any equipment or materials be placed or stored within twenty-five (25) feet from the centerline of an outside track, except as approved by the Site Specific Safety Work Plan.** To insure compliance with this requirement, Permittee and/or Contractors **must establish a twenty-five (25) foot foul line prior to the start of work** by either driving stakes, taping off or erecting a temporary fence, or providing an alternate method as approved by the Chief Engineer's representative. Permittee and/or Contractors will be issued warning stickers which must be placed in the operating cabs of all equipment as a constant reminder of the twenty-five (25) foot clearance envelope.

3.10 STORAGE OF MATERIALS AND EQUIPMENT

- A. No material or equipment shall be stored on Railroad's property without first having obtained permission from the Chief Engineer. Any such storage will be on the condition that Railroad will not be liable for loss of or damage to such materials or equipment from any cause.
- B. If permission is granted for the storage of compressed gas cylinders on Railroad property, they shall be stored a minimum of 25 feet from the nearest track in an approved lockable enclosure. The enclosure shall be locked when the Permittee and/or Contractor is not on the project site.

3.11 CONDITION OF RAILROAD'S PROPERTY

- A. Permittee and/or Contractors shall keep Railroad's property clear of all refuse and debris from its operations. Upon completion of the work, Permittee and/or Contractors shall remove from Railroad's property all machinery, equipment, surplus materials, falsework, rubbish, temporary structures, and other property of the Permittee and/or Contractors and shall leave Railroad's property in a condition satisfactory to the Chief Engineer.

3.12 SAFETY TRAINING

- A. All individuals, including representatives and employees of the Permittee and/or Contractors, before entering onto Railroad's property or coming within twenty-five (25) feet of the centerline of the track or energized wire shall first attend Railroad's Safety Contractor/Leasee Employee Training Class. The Safety Orientation Class will be provided by Railroad's Safety Representative at Permittee's expense. A photo I.D. will be issued and must be worn/displayed while on Railroad property. All costs of complying with Railroad's safety training shall be at the sole expense of Permittee. Permittee and/or Contractors shall appoint a qualified person as their Safety Representative. The Safety Representative shall continuously assure that all individuals comply with Railroad's safety requirements. All safety training records shall be maintained with site specific work plan.

3.13 NO CHARGES TO RAILROAD

- A. It is expressly understood that neither these Specifications, nor any document to which they are attached, include any work for which Railroad is to be billed by Permittee and/or Contractors, unless Railroad gives a written request that such work be performed at Railroad's expense.

END OF SECTION 01141A

SECTION 01142A -SUBMISSION DOCUMENTATION REQUIRED FOR AMTRAK REVIEW AND APPROVAL OF PLANS FOR BRIDGE ERECTION, DEMOLITION AND OTHER CRANE/ HOISTING OPERATIONS OVER RAILROAD RIGHT -OF-WAY

PART 1 -GENERAL

1.1 SCOPE

- A. Amtrak requires that a site-specific work plan for accomplishing hoisting operations be prepared for every applicable project, and for each type of lift on a project.
 - 1. The plan shall demonstrate adherence to Amtrak safety rules.
 - 2. The plan shall demonstrate constructability.
 - 3. The plan shall minimize impact to rail operations.
 - 4. The approved plan will provide the basis for field inspection and verification of the actual work.
- B. Preparation, review and approval of the Crane/ Hoisting site-specific work plan does not relieve the Contractor from meeting other Amtrak requirements for adequate planning and documentation of proposed work procedures within the Right-of-Way of the railroad.
- C. Current Amtrak safety rules shall be adhered to in every respect.
- D. Use of this specification is as required by Amtrak, as described in Amtrak Engineering Practice EP3014.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division I Specification Sections, apply to this Section.

1.3 DEFINITIONS

- A. CHIEF ENGINEER: Amtrak Vice President, Chief Engineer
- B. RAILROAD: National Railroad Passenger Corporation (Amtrak), and/or the duly authorized representative
- C. ENGINEERING PRACTICE: Amtrak Engineering Practices establish a system of uniform practices, notices and instructions for the Amtrak Engineering Department, providing current, permanent and temporary, departmental procedures and policies.

1.4 SUBMISSION REQUIREMENTS

- A. Unless otherwise directed in the Contract, the Contractor shall submit five sets of plans and calculations to the authorized representative of the Chief Engineer, Structures, whose name and address will be provided at the project pre-construction meeting.

- B. Submitted calculations and plans shall be signed and sealed by a Professional Engineer, registered in the State in which the work will be performed.
- C. The Contractor shall revise and resubmit plans and calculations as many times as necessary, until a complete and correct site-specific work plan for crane/ hoisting operations has been approved.

PART 2 -PRODUCTS (Not Used)

PART 3 -EXECUTION

THE CONTRACTOR SHALL PROVIDE, AT A MINIMUM, THE FOLLOWING INFORMATION FOR REVIEW AND APPROVAL BY AMTRAK ENGINEERING STRUCTURES:

- A. Plan view showing location(s) of cranes, operating radii, with delivery and/or disposal locations shown. Provide all necessary dimensions for locating the elements of the plan.
- B. Plans and computations showing the weight of the pick.
- C. Crane rating sheets, demonstrating that cranes are adequate for 150% of the calculated pick weight. That is, the cranes shall be capable of picking 150% of the load, while maintaining normal, recommended factors of safety. The adequacy of the crane for the proposed pick shall be determined by using the manufacturer's published crane rating chart and not the maximum crane capacity. Crane and boom nomenclature is to be indicated.
- D. Calculations demonstrating that slings, shackles, lifting beams, etc. are adequate for 150% of the calculated pick weight.
- E. Location plan showing obstructions, indicating that the proposed swing is possible. "Walking" of load using two cranes will not be permitted. Rather, multiple picks and repositioning of the crane may be permitted to get the load to the needed location for the final pick, if necessary.
- F. Data sheet listing types and sizes of slings and other connecting equipment. Include copies of catalog cuts for specialized equipment. Detail attachment methods on the plans.
- G. A complete procedure, indicating the order of lifts and any repositioning or re-hitching of the crane or cranes.
- H. Temporary support of any components or intermediate stages, as may be required.
- I. A time schedule of the various stages, as well as a schedule for the entire lifting process.

END OF SECTION 01142A

SUBMISSION DOCUMENTATION REQUIRED FOR AMTRAK REVIEW AND APPROVAL OF PLANS FOR BRIDGE ERECTION, DEMOLITION AND OTHER CRANE/ HOISTING OPERATIONS OVER RAILROAD RIGHT OF WAY

SECTION 01520A – REQUIREMENTS FOR TEMPORARY PROTECTION SHIELDS FOR DEMOLITION AND CONSTRUCTION OF OVERHEAD BRIDGES AND OTHER STRUCTURES

PART 1 – GENERAL

1.1 SCOPE

- A. This specification describes items to be included in the design and construction of temporary protection shields for construction overhead and near to Amtrak tracks.
- B. Use of this specification is as required by Amtrak, as described in Amtrak Engineering Practice EP3014.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.3 DEFINITIONS

- A. CHIEF ENGINEER: Amtrak Vice President, Chief Engineer
- B. RAILROAD: National Railroad Passenger Corporation (Amtrak), and/or the duly authorized representative
- C. ENGINEERING PRACTICE: Amtrak Engineering Practices establish a system of uniform practices, notices and instructions for the Amtrak Engineering Department, providing current, permanent and temporary, departmental procedures and policies.

1.4 SUBMISSION REQUIREMENTS

- A. Unless otherwise directed in the Contract, the Contractor shall submit five sets of plans and calculations to the authorized representative of the Chief Engineer, Structures, whose name and address will be provided at the project pre-construction meeting.
- B. Submitted calculations and plans shall be signed and sealed by a Professional Engineer, registered in the State in which the work will be performed.
- C. The Contractor shall revise and resubmit plans and calculations as many times as necessary, until a complete and correct site-specific work plan for crane/hoisting operations has been approved.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 CONTRACTORS WORKING ON OVERHEAD OR NEARBY DEMOLITION AND/OR CONSTRUCTION ADJACENT TO AMTRAK TRACKS, SHALL CONFORM TO THE FOLLOWING

3.2 DESIGN AND CONSTRUCTION REQUIREMENTS FOR TEMPORARY PROTECTION SHIELDING:

- A. The Contractor shall maintain a specified level of protection to railroad facilities, during demolition and construction activities that occur overhead and nearby Amtrak tracks, as shown on the Contract Plans, as detailed in the Contract Specifications, and as described below.
- B. Prior to the start of construction, the Contractor shall submit to Amtrak for review and approval, detailed site specific plans for temporary protection shields. The plans will be reviewed as to the methods of erection, and as to whether or not the proposed installation will provide the required level of protection. No construction shall proceed until the Contractor has received written approval of the Contractor's complete, site specific plans, from Amtrak.
- C. The Contractor shall design the protection shields to conform to all applicable and governing federal, state and local laws and regulations.
- D. Drawings for the proposed temporary protection shields shall be signed and sealed by a Licensed Professional Engineer. Complete design calculations, clearly referenced to the drawings, and easy to review, shall be provided with submission of drawings.
- E. Protection shields shall be designed for the following, minimum load and size criteria.
 - 1. The horizontal shield design live load on horizontal surfaces shall be the greater of a minimum of 100 pounds per square foot (psf) [5000 Pascals] or the anticipated live load to be produced by the Contractor's anticipated operations. When determining the appropriate design live load, the designer shall consider factors such as the physical capacity of proposed debris-catching platforms to retain materials, and the type of equipment the platforms might support. Positive means of demolition and construction controls shall be provided to assure that debris that may collect on the shield will not exceed the design live load. The horizontal protection shield, in plan view, shall cover no less than the area directly over the tracks plus ten feet minimum beyond the centerline of the outermost tracks.
 - 2. The vertical shield shall be designed to carry a minimum 30 psf [1500 Pascals] allowance for wind load. The vertical shield shall extend a minimum of 6'-6" [1950 millimeters] above the top of the adjacent surface, such as curb or sidewalk. Anti-climb wings shall be installed at each end, as necessary, to restrict access to the railroad property.
- F. The vertical and horizontal clearance envelopes required for maintenance of railroad operations, shall be indicated on the site specific work plans. These clearances are subject to review and approval by Amtrak. If applicable, both temporary and permanent envelopes shall be indicated on the plans. The temporary protection shields shall be installed outside the limits of these minimum vertical and horizontal clearances shown on the site specific work plans.
- G. In electrified territory, temporary protection shields shall be bonded and grounded.
- H. Temporary protection shields shall be designed and constructed to prevent dust, debris, concrete, formwork, paint, tools, or anything else from falling onto the railroad property below.
- I. The temporary protection shields shall be attached to the structure in accordance with site specific work plans submitted by the Contractor and approved by Amtrak. Drilling in structural members and welding will generally not be permitted in members that are scheduled to remain in place in the reconstructed structure. For existing members scheduled for demolition or for later reconstruction, any proposed attachment shall be designed with consideration of potential existing, deteriorated conditions.
- J. The Contractor shall provide the Amtrak on-site representative, for review and approval prior to any construction activity in the effected area, a proposed construction schedule for the installation, maintenance and removal of the temporary protection shields.

- K. The temporary protection shields shall be installed prior to the start of any other work over the railroad in the effected areas. No construction shall proceed until the Amtrak on-site representative reviews and approves the Contractor's installed protection. Before proceeding with the work, Amtrak must be satisfied, in its sole judgement, that sufficient protection has been provided to proceed with the work.
- L. The Contractor shall install and remove temporary protection shields only when an Amtrak representative is on-site.
- M. The Contractor shall not install or remove temporary protection shields during train operations.
- N. Temporary protection shields shall remain in place for the duration of construction activities over and nearby the railroad in the effected areas. The Contractor may remove temporary construction only after approved by Amtrak on-site representatives.
- O. Where site specific conditions impose insurmountable restrictions to the design of temporary construction conforming to the limitations listed above, the design of temporary construction shall be developed in close coordination with Amtrak design review personnel. The Chief Engineer, Structures shall Provide final approval of temporary construction that does not conform to the above limitations.

END OF SECTION 01520A

SECTION 02261A – REQUIREMENTS FOR TEMPORARY SHEETING AND SHORING TO SUPPORT AMTRAK TRACKS

PART1-GENERAL

1.1 SCOPE

- A. This engineering practice describes items to be included in the design and construction of temporary sheeting and shoring construction adjacent and proximate to Amtrak tracks.
- B. Use of this specification is as required by Amtrak, as described in Amtrak Engineering Practice EP3014.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.

1.3 DEFINITIONS

- A. CHIEF ENGINEER: Amtrak Vice President, Chief Engineer
- B. RAILROAD: National Railroad Passenger Corporation (Amtrak), and/or the duly authorized representative.
- C. ENGINEERING PRACTICE: Amtrak Engineering Practices establish a system of uniform practices, notices and instructions for the Amtrak Engineering Department, providing current, permanent and temporary, departmental procedures and policies.

1.4 SUBMISSION REQUIREMENTS

- A. Unless otherwise directed in the Contract, the Contractor shall submit five sets of plans and calculations to the authorized representative of the Chief Engineer, Structures, whose name and address will be provided at the project pre-construction meeting.
- B. Submitted calculations and plans shall be signed and sealed by a Professional Engineer, registered in the State in which the work will be performed.
- C. The Contractor shall revise and resubmit plans and calculations as many times as necessary, until a complete and correct site-specific work plan for temporary sheeting and shoring has been approved.

PART 2 -PRODUCTS (Not Used)

PART 3 -EXECUTION

- 3.1 CONTRACTORS INSTALLING TEMPORARY CONSTRUCTION SHEETING AND SHORING TO SUPPORT AMTRAK TRACKS SHALL CONFORM TO THE FOLLOWING:
- A. Footings for all piers, columns, walls, or other facilities shall be located and designed so that any temporary sheeting and shoring for support of adjacent track or tracks during construction will not be closer than toe of ballast slope. The dimension from gage of rail to toe of ballast, along tangent track, is 7'-5"; see dimensions on Track standard plans for curved track dimensions.
 - B. USE OF SHEETING: When support of track or tracks is necessary during construction of the above-mentioned facilities, interlocking steel sheeting, adequately braced and designed to carry Cooper E80 live-load plus 50 percent impact allowance is required. Soldier piles and lagging will be permitted for track support ONLY when required penetration of steel sheet piling cannot be obtained, due to site-specific conditions that make steel sheet piling placement impracticable, in the opinion of the authorized, Amtrak design review engineer.
 - 1. For usual soil conditions and limited excavations, sheeting is required when the near-track excavation extends beneath or nearer to the track than the Theoretical Railroad Embankment Line. The Theoretical Railroad Embankment Line is defined as a line that starts at grade, ten foot from the centerline of the outer track, and extends downward, away from the track, at a slope of 1-1/2 horizontal to one vertical.
 - 2. For special soil conditions, such as soft organic soils and rock conditions, and for unusual excavation conditions, temporary supports for excavations may be necessary even when the limits fall beyond the Theoretical Railroad Embankment Line, requiring site specific analysis by a professional, geotechnical engineer.
 - 3. See Sketch SK-1, "Normal Requirements for Sheet Piling Adjacent to Tracks".
 - C. Exploratory trenches, three feet deep and 15 inches wide in the form of an "H", with outside dimensions matching the proposed outside dimensions of sheeting, shall be hand dug, prior to placing and driving the sheeting, in any area where railroad or utility underground installations are known or suspected. These trenches are for exploratory purposes only, and shall be backfilled and immediately compacted, in layers. This work shall be performed only in the presence of a railroad inspector.
 - D. Absolute use of track is required while driving sheeting adjacent to running track. Track usage shall be prearranged per standard procedures, through the Amtrak project representative.
 - E. Cavities adjacent to sheet piling, created by pile driving, shall be filled with sand, and any disturbed ballast shall be restored and tamped immediately.
 - F. Sheet piling cutoffs
 - 1. During construction, sheeting shall be cut off at an elevation no higher than the top of tie.
 - 2. At the completion of construction activities involving the use of sheet piling, sheet piling may be pulled if there will be no adverse impact to the railroad track support bed, as determined by the Amtrak site engineer. This will generally be permitted when both of these conditions are met:
 - a. the sheeting face is at least ten feet distant from the centerline of track, and
 - b. the bottom of the excavation that the sheeting supported prior to backfilling, does not

fall

within an assumed influence zone under the tracks. The assumed influence zone is defined as the area, as seen in cross-sectional view, falling beneath the Theoretical

Underground Track Disturbance Line. This line is defined as a line that starts at the end and bottom of the ties, and extends from the track outward and downward at a one-to-one (45-degree) slope.

3. Sheet piling that is to be left in-place, shall be cut off below the ground line
 - a. at least eighteen inches below final ground line at the sheeting, and
 - b. no higher than 24 inches below the elevation of the bottom of the nearest ties
 4. See Sketch SK-1, "Normal Requirements for Sheet Piling Adjacent to Tracks".
- G. The excavation adjacent to the track shall be covered, ramped and protected by handrails, barricades and warning lights, as required by applicable safety regulations, and as directed by Amtrak.
- H. Final backfilling of excavation shall conform to project specifications.
- I. The Contractor shall provide Amtrak with a detailed schedule of proposed construction operations, detailing each step of the proposed temporary construction operations in proximity to Amtrak tracks, so that Amtrak may review and approve the proposed operations, and may properly inspect and monitor operations.
- J. Drawings for the proposed temporary sheeting and shoring shall be signed and sealed by a Licensed Professional Engineer. Complete design calculations, clearly referenced to the drawings, and easy to review, shall be provided with submission of drawings.
- K. Where site specific conditions impose insurmountable restrictions to the design of temporary construction conforming to the limitations listed above, the design of temporary construction shall be developed in close coordination with Amtrak design review personnel. The Chief Engineer, Structures shall provide final approval of temporary construction that does not conform to the above limitations.
 1. When Amtrak grants approval for sheeting closer than standard minimum clearances, the Contractor shall develop a survey plan, if not already required by the project, for the adjacent tracks, to be conducted prior to, during, and after the temporary sheeting construction operations. If settlement is detected, construction operations shall be suspended until the track has been returned to its initial condition, and stabilized, as determined by the Amtrak project site representative.
 2. The Contractor shall stockpile ten (10) tons of approved ballast at the project site, and maintain that amount in ready reserve, to allow for the possible need to restore track profile.
- L. Particular care shall be taken in the planning, design and execution of temporary construction, as relates to railroad slope protection and drainage facilities. Erosion and sediment control best management practices shall be designed and employed, as approved by Amtrak. Any unintended disruption to railroad drainage facilities, caused by the temporary construction, shall be promptly remedied, as directed by the Engineer, solely at the Contractor's cost.
- M. The following Information Sketch is attached:

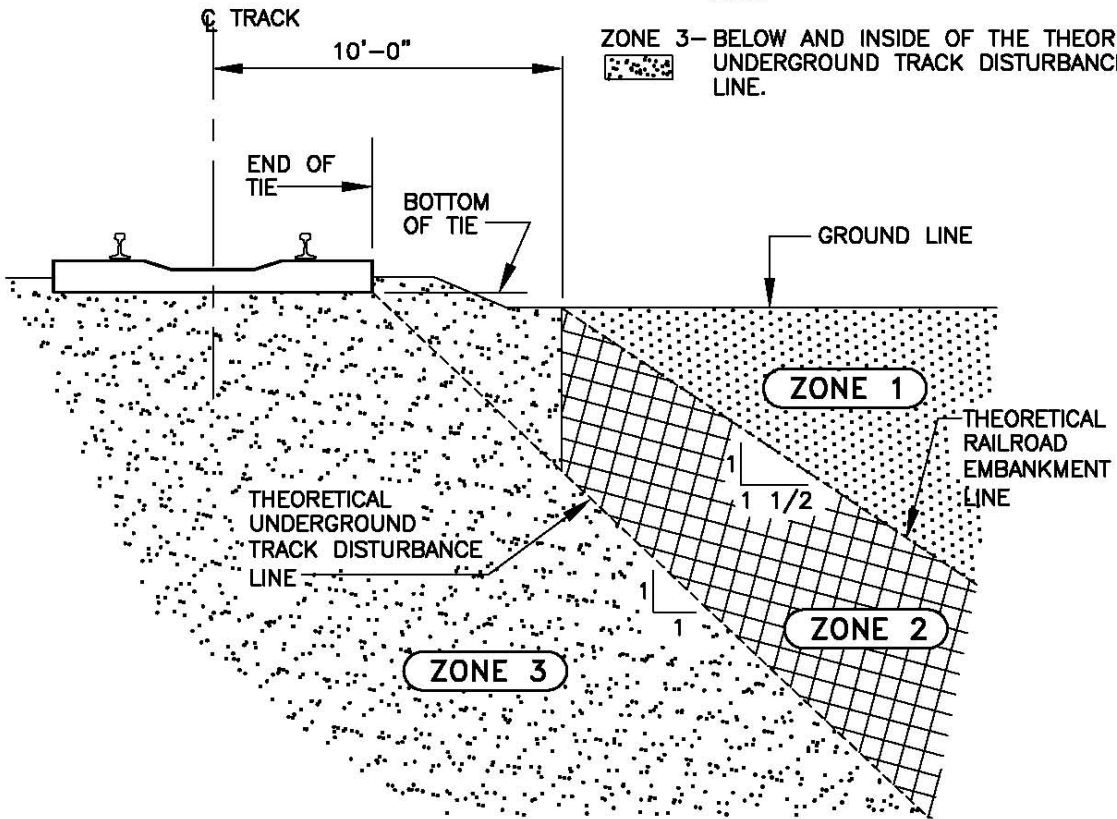
1 Figure No. SK-1: Normal Requirements for Sheet Piling Adjacent to Track

LEGEND

ZONE 1— ABOVE AND OUTSIDE THE THEORETICAL RAILROAD EMBANKMENT LINE.

ZONE 2— FARTHER THAN 10 FEET FROM THE CENTERLINE OF TRACK, BELOW THE THEORETICAL RAILROAD EMBANKMENT LINE AND ABOVE THE THEORETICAL UNDERGROUND TRACK DISTURBANCE LINE.

ZONE 3— BELOW AND INSIDE OF THE THEORETICAL UNDERGROUND TRACK DISTURBANCE LINE.



**NORMAL REQUIREMENTS FOR SHEET PILING
ADJACENT TO TRACK**

- ① EXCAVATIONS WITHIN ZONE 1 — ABOVE AND OUTSIDE OF THE THEORETICAL RAILROAD EMBANKMENT LINE — DO NOT NORMALLY REQUIRE SHEETING TO PROTECT RAILROAD ROAD BED. SHEETING MAY BE REQUIRED FOR OTHER REASONS.
- ② EXCAVATIONS WHOSE BOTTOMS EXTEND INTO ZONE 2 REQUIRE SHEETING, BUT THE SHEETING MAY NORMALLY BE PULLED AFTER THE EXCAVATION HAS BEEN BACKFILLED.
- ③ EXCAVATIONS WHOSE BOTTOMS EXTEND INTO ZONE 3 WILL NORMALLY REQUIRE THE SHEETING TO BE LEFT IN PLACE AND CUT-OFF PER REQUIREMENTS.

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Office of Chief Engineer
STRUCTURES

National Railroad Passenger Corporation
30th Street Station, Philadelphia, Pennsylvania 19104

SKETCH 1
SPEC. 02261A - REV. 1

Designed CJR Drawn JLM Date 6/06/01

File No:	
Design No:	3501
Sheet No:	1 of 1
SK-1	

END OF SECTION 02261A

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected site elements.
2. Salvage of existing items to be reused or recycled.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.

3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.06.25 – “Facilities Construction – Product Selection”.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure passenger rail service are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.
- D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations.

1.7 CLOSEOUT SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.06.25 – “Facilities Construction – Product Selection”.
- B. Inventory: Submit a list of items that have been removed and salvaged.

1.8 FIELD CONDITIONS

- A. The public will occupy portions of the facility immediately adjacent to selective demolition area. Conduct selective demolition so operations will not be disrupted.
- B. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer.

- D. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with passenger boarding operations.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
 - 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
 - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Engineer will arrange to shut off indicated services/systems when requested by Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.3 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 8. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
 1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area off-site as designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site.
 1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Remove: Portions of concrete platform, foundation walls, footings.
- B. Remove: Passenger wayfinding signage
- C. Remove/Reinstall: South Platform guardrails, handrails

Refer to the contract drawings for additional information and limits of selective demolition.

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Metro-North Railroad regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the Notices to Contractor and other specifications in the Contract.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Signage Piers.
 - 4. Slabs-on-grade.
 - 5. Mechanical equipment pads.
- B. Related Sections:
 - 1. Section 071900 "Water Repellents".
 - 2. Section 099610 "Graffiti Control" for application of graffiti control coatings.
 - 3. Section 099613 "Interior Epoxy Painting".
 - 4. Section 079200 "Joint Sealants".
 - 5. Section 104250 "Site Wayfinding & Identification Signage"

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.06.25 – "Facilities Construction – Product Selection".

- B. Product Data: For each type of product indicated.
- C. Evidence that concrete materials have been tested and the test results are on file with the State of Connecticut Department of Transportation Laboratory.
- D. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- E. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.06.25 – “Facilities Construction – Product Selection”.
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Waterstops.
 - 6. Curing compounds.
 - 7. Floor and slab treatments.
 - 8. Bonding agents.
 - 9. Adhesives.
 - 10. Vapor retarders.
 - 11. Semi-rigid joint filler.
 - 12. Joint-filler strips.
 - 13. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- E. Field quality-control reports.
- F. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. **Installer Qualifications:** A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. **Manufacturer Qualifications:** A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. **Testing Agency Qualifications:** An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. **Source Limitations:** Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer in accordance with Form 817 Article 1.20-1.06.01
- E. **Welding Qualifications:** Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- F. **Mockups:** Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
 - 1. Build panel approximately 100 sq. ft. for slab-on-grade and 50 sq. ft. for formed surface, as directed by the Architect.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- G. **ACI Publications:** Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- H. **Concrete Testing Service:** Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- I. **Preinstallation Conference:** Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.

2. Review Amtrak requirements for work near tracks, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 817 Articles 1.20-1.06.03 – “Facilities Construction – Storage” and 1.20-1.06.05 – “Facilities Construction – Shipping Material”.
- B. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
- C. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete (All visible areas): Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. Structural 1, B-B or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete (Areas concealed from view): Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not

exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- F. Form-Release 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.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, 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. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in 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, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.
- C. Steel Bar Mats: ASTM A-184, fabricated from ASTM A-615, Grade 60, deformed bars, assembled with clips.
- D. Deformed-Steel Wire: ASTM A 496.
- E. Epoxy-Coated Wire: ASTM A 884, Class A, Type 1 coated, as-drawn, plain deformed-steel wire, with less than 2 percent damaged coating in each 12-inch wire length.
- F. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- G. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.
- H. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884, Class A coated, Type 1, plain steel.

2.3 REINFORCEMENT ACCESSORIES

- A. Epoxy-Coated Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, ASTM A 775 epoxy coated.
- B. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775.

- C. 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 precast 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.

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 I/II (Type II when in contact with earth).
 - a. Fly Ash: ASTM C 618, Class F or C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

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/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
 - b. CETCO; Volclay Waterstop-RX.
 - c. Concrete Sealants Inc.; Conseal CS-231.
 - d. Greenstreak; Swellstop.
 - e. Henry Company, Sealants Division; Hydro-Flex.
 - f. JP Specialties, Inc.; Earth Shield Type 20.

2.7 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
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. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
 - b. Fortifiber Building Systems Group; Moistop Ultra 10.
 - c. Grace Construction Products, W. R. Grace & Co.; Florprufe 120.
 - d. Meadows, W. R., Inc.; Perminator 10 mil.
 - e. Raven Industries Inc.; Vapor Block 10.
 - f. Stego Industries, LLC; Stego Wrap 10 mil Class A.

2.8 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing 3/8-inch sieve.
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. Anti-Hydro International, Inc.; Emery Non-Slip.
 - b. Dayton Superior Corporation; Emery Tuff Non-Slip.
 - c. Lambert Corporation; EMAG-20.
 - d. L&M Construction Chemicals, Inc.; Grip It.
 - e. Metalcrete Industries; Metco Anti-Skid Aggregate.

2.9 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
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. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
 - b. BASF Construction Chemicals - Building Systems; Confilm.
 - c. ChemMasters; SprayFilm.
 - d. Conspec by Dayton Superior; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. L&M Construction Chemicals, Inc.; E-CON.
 - i. Meadows, W. R., Inc.; EVAPRE.
 - j. Metalcrete Industries; Waterhold.
 - k. Sika Corporation; SikaFilm.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class 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. BASF Construction Chemicals - Building Systems; Kure 1315.
 - b. ChemMasters; Polyseal WB.
 - c. Conspec by Dayton Superior; Sealcure 1315 WB.
 - d. Edoco by Dayton Superior; Cureseal 1315 WB.
 - e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
 - f. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - g. Meadows, W. R., Inc.; Vocomp-30.
 - h. Metalcrete Industries; Metcure 30.

2.10 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.11 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 5000 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface 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 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.12 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: 25 percent.

2. Ground Granulated Blast-Furnace Slag: 50 percent.
 3. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, 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.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 5000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.40 unless strength data is available.
 3. Slump Limit: 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
- B. Foundation Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 5000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
- C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 5000 psi at 28 days.
 2. Minimum Cementitious Materials Content: 660 lb/cu. yd..
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
 5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.14 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.15 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, 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.

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 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/16 inch for exterior exposed to view smooth-formed finished surfaces.
 - 2. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 3. Class B, 1/4 inch for rough-formed finished 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 permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, 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 required for adjoining work that is attached to or 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."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

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. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be 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 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Granular Course: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.

3.6 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/D 1.4M, 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.

3.7 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 Designer.
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 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.

3.8 WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 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 Engineer.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will 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.
- D. 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. Scream 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 bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. 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 subgrade or on subgrade 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.

F. 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 subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces not exposed to public view. Applies to formed foundation walls not exposed to public view such as utility building.
- 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, to receive a rubbed finish. Applies to formed foundation walls exposed to public view, such as signage piers, concrete ramp foundation walls, and utility foundation wall between grade and cast stone.
- C. 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.

3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
 1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces exposed to view.
 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 gap at any point between concrete surface and an unveled, freestanding, 10-ft.- 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 only where indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- F. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
 2. After broadcasting and tamping, apply float finish.
 3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. 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. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.13 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.
- 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.
 - 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. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
 - 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.

3.14 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect'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 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. 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 Architect.
- 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, popouts, 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 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.
 5. 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.
 6. 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 Designer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

- A. Testing and Inspecting: General Contractor shall procure services of qualified independent testing and inspecting agency to conduct the required testing..
- B. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- 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 at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

- 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/C 143M; 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 concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; 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/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one laboratory-cured specimen at 7 days and one set of two specimens at 28 days. Hold last specimen for possible 56 day test.
 - a. 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 Architect, 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 Architect 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 Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

- D. Measure floor and slab flatness and/or levelness according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION 033000

SECTION 042113 - BRICK MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Face brick
 - 2. Mortar and grout
 - 3. Ties and anchors
 - 4. Embedded flashing
 - 5. Miscellaneous masonry accessories
- B. Related Sections:
 - 1. Section 047200 "Cast Stone Masonry" for furnishing cast stone at brick masonry veneer.
 - 2. Section 055000 "Metal Fabrications" for furnishing steel lintels and shelf angles for brick masonry.
 - 3. Section 099610 "Graffiti Control" for application of graffiti control coatings.
 - 4. Section 079200 "Joint Sealants".
 - 5. Section 089000 "Louvers and Vents".

1.3 PERFORMANCE REQUIREMENTS

- A. FM Global Listing: Provide brick and component materials that comply with Data Sheet 1-28. The storefront within the following zones of the building should be designed to withstand an outward horizontal wind force of 46 psf in the field (Zone 4) and 46 psf in the corners (Zone 5) and an inward force of 49 psf in the field and 58 in the corners of the wall. Identify materials with FM Global markings.

1.4 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- 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.
- D. Samples for Initial Selection:
 - 1. Colored mortar for selection by Architect.
- E. Samples for Verification: For each type and color of the following:
 - 1. Face brick, including cut brick.
 - 2. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.
 - 3. Weep holes and vents.
 - 4. Accessories embedded in masonry.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 - 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- C. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - 1. Include data on material properties.
 - 2. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - 3. For exposed brick, include test report for efflorescence according to ASTM C 67.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Grout mixes. Include description of type and proportions of ingredients.
 - 5. Anchors, ties, and metal accessories.

- D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate in accordance with Form 817 Article 1.20-1.06.01.
- C. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
 - 1. Build sample panel for exposed unit masonry construction 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 one-half of exposed faces of panels with masonry cleaner indicated.
 - 4. Protect approved sample panels from the elements with weather-resistant membrane.
 - 5. Approval of sample panel 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 Architect in writing.
 - 1. Approval of sample panel does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. 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.

- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- F. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 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 of walls and hold cover securely in place.
- B. 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.
- C. 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 higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: If indicated on drawings, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 - 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 - 4. Provide corner units and special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: Facing brick complying with ASTM C 216.
 - 1. Products: Subject to compliance with requirements, provide one of the following, or approved equal:
 - 1. Glen-Gery, modular face brick, extruded cored. Color of brick to match existing station building as selected by the Architect.
 - 2. Grade: SW.
 - 3. Type: FBS
 - 4. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
 - 5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
 - 6. Full Brick Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
 - 7. Cut Brick Size (Actual Dimensions): 3/4 inch wide by 2-1/4 inches high by 7-5/8 inches long.
 - 8. Corner Units and Special Shapes Size: varies.

2.3 MORTAR 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 and hydrated lime containing no other ingredients.
- D. Mortar Cement: ASTM C 1329.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Lafarge North America Inc.
 - 2. Approved equal.
- E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Davis Colors; True Tone Mortar Colors.
 - 2. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
 - 3. Solomon Colors, Inc.; SGS Mortar Colors.
- F. Colored Cement Product: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. 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 Portland & Lime.
 - 4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
 - 2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 - 3. Pigments shall not exceed 10 percent of portland cement by weight.
- G. 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.

2.4 REINFORCEMENT

- A. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
- B. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch- diameter, stainless-steel continuous wire.

2.5 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 1. Stainless-Steel Wire: ASTM A 580/A 580M, Type 316.
 2. Stainless-Steel Sheet: ASTM A 666, Type 316.
 3. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.
- B. Adjustable Anchors for Connecting to Structural Steel Framing: 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, stainless-steel wire.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.25-inch- diameter, stainless-steel wire.
- C. 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 concrete unit masonry, and as follows:
 1. 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. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:
 3. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Dayton Superior Corporation, Dur-O-Wal Division
- 2) Heckmann Building Products Inc
- 3) Hohmann & Barnard, Inc
- 4) Wire-Bond

2.6 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch, galvanized steel sheet.

2.7 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel or copper, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Cheney Flashing Company;
- 2) Keystone Flashing Company, Inc.
- 3) Sandell Manufacturing Co., Inc.

4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
6. Fabricate metal drip edges for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
7. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
8. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.

9. Metal Expansion-Joint Strips: Fabricate from stainless steel or copper to shapes indicated.

B. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge or flexible flashing with a metal drip edge.
4. Where flashing is fully concealed, use metal flashing.

C. Solder and Sealants for Sheet Metal Flashings:

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Elastomeric Sealant: ASTM C 920, chemically curing urethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.8 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. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

C. Weep/Vent Products: Use one of the following unless otherwise indicated:

1. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2 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.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Advanced Building Products Inc.; Mortar Maze weep vent.
- 2) Blok-Lok Limited; Cell-Vent.
- 3) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
- 4) Heckmann Building Products Inc.; No. 85 Cell Vent.
- 5) Hohmann & Barnard, Inc.; Quadro-Vent.
- 6) Wire-Bond; Cell Vent.

3. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, 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.

1. 1375: Subject to compliance with requirements, provide the following, or approved equal:

1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.

D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, provide one of the following, or approved equal:

1. Advanced Building Products Inc.; Mortar Break II.
2. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
3. Mortar Net USA, Ltd.; Mortar Net.

2. Provide one of the following configurations:

1. Strips, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.

2.9 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

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:

1. Diedrich Technologies, Inc.
2. EaCo Chem, Inc.
3. ProSoCo, Inc.

2.10 MORTAR 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.
2. Use portland cement-lime mortar unless otherwise indicated.
3. 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 Type N unless another type is indicated.
- D. Pigmented Mortar: Use colored cement product.
 - 1. Pigments shall not exceed 10 percent of portland cement by weight.
 - 2. Mix to match Architect's sample.
 - 3. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - 1. Face brick.
 - 2. Cast stone trim units.
- 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 Architect's sample.
 - 2. Application: Use colored aggregate mortar for exposed mortar joints with the following units:
 - 1. Face brick.
 - 2. Cast stone trim units.

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 the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- B. 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.
- C. 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.

- D. 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.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. 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.
7. 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.

C. Joints:

1. For 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.
2. 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.
3. 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.

3.4 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 running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. 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.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

- A. 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.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
 - 1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry 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.

3.7 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 - 2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.

3. Embed tie sections in masonry joints. Provide air space between back of masonry veneer and face of sheathing as shown on the drawings.
4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
5. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

3.8 EXPANSION JOINTS

- A. General: Install expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form expansion joints in brick as follows:
 1. Build in compressible joint fillers where indicated.
 2. 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 Section 079200 "Joint Sealants."
- C. 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 Section 079200 "Joint Sealants," but not less than 3/8 inch.
 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.9 LINTELS

- A. Install steel lintels where indicated.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 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. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, 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 masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under building paper or building wrap, lapping at least 4 inches.
 3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 4. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
 5. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
 6. 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.
- 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.
 4. Space weep holes formed from plastic tubing or wicking material 16 inches o.c.
 5. Trim wicking material flush with outside face of wall after mortar has set.
- E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products or open head joints to form vents.
1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.
- G. Cavity below the bottom level of flashing above grade should be grouted solid.

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
- C. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

3.12 REPAIRING, 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. Install new units 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 Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 3. Protect adjacent stone and nonmasonry 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.
 7. Clean stone trim to comply with stone supplier's written instructions.
 8. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.13 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION 042113

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Mortar and grout.
 - 3. Steel reinforcing bars.
 - 4. Masonry joint reinforcement.
 - 5. Ties and anchors.
 - 6. Miscellaneous masonry accessories.
- B. Related Sections:
 - 1. Section 047200 "Cast Stone Masonry" for furnishing cast stone trim.
 - 2. Section 055000 "Metal Fabrications" for loose steel lintels.
 - 3. Section 072100 "Thermal Insulation" for molded expandable polystyrene concrete masonry unit core inserts.
 - 4. Section 099613 "Interior Epoxy Painting".

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: General Contractor shall procure services of qualified independent testing and inspecting agency to conduct the required testing. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
 1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
 2. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.6 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- 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.

1.7 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Qualification Data: For testing agency.
- C. Material Certificates: For each type and size of the following:
 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 2. Cementitious materials. Include brand, type, and name of manufacturer.
 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 4. Grout mixes. Include description of type and proportions of ingredients.
 5. Reinforcing bars.
 6. Joint reinforcement.
 7. Anchors, ties, and metal accessories.

- D. **Mix Designs:** For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- E. **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.
- F. **Cold-Weather and Hot-Weather Procedures:** Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.8 QUALITY ASSURANCE

- A. **Testing Agency Qualifications:** Qualified according to ASTM C 1093 for testing indicated.
- 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, from single source from single manufacturer for each product required in accordance with Form 817 Article 1.20-1.06.01.
- C. **Source Limitations for Mortar Materials:** Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate in accordance with Form 817 Article 1.20-1.06.01.
- D. **Masonry Standard:** Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.9 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 use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- F. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.10 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 of walls and hold cover securely in place.
- B. Do not apply uniform roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls.
- 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 higher 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 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

2.2 CONCRETE MASONRY UNITS

A. CMUs: ASTM C 90.

1. Density Classification: Normal weight.
2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

2.3 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 and hydrated lime containing no other ingredients.

D. 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.

E. Aggregate for Grout: ASTM C 404.

F. Water: Potable.

2.4 REINFORCEMENT

A. Steel Reinforcing Bars: ASTM A 615/A 615M, Grade 60 epoxy coated according to ASTM A775/A775M.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
6. 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.

2.5 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.

2.6 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 or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 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. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - b. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - c. Wire-Bond; Figure 8 Rebar Positioner.

2.7 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. Use portland cement-lime mortar unless otherwise indicated.
- 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 reinforced masonry, use Type N.

- D. 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. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 3000 psi.
 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

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 the 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. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- C. 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.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.

3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. 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.

C. Joints:

1. For 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.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 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 running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. 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 before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. 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.

- F. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- G. 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.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs 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 exposed joints 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.

3.6 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.
- 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.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. 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 using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.8 REINFORCED UNIT MASONRY INSTALLATION

- A. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- B. 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.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.9 FIELD QUALITY CONTROL

- A. Testing and Inspecting: General Contractor shall procure services of qualified independent testing and inspecting agency to conduct the required testing. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- D. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- E. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.10 REPAIRING, 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. Install new units 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 Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry 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 concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.11 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste.
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 – 2016, and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section includes cast stone for the following exterior vertical surfaces of the utility building:
 - 1. Base
 - 2. Header
- B. Related Sections:
 - 1. Section 042113 "Brick Masonry" for installing cast stone units in brick masonry.
 - 2. Section 099610 “Graffiti Control” for application of graffiti control coatings.
 - 3. Section 042200 “Concrete Masonry Unit”.
 - 4. Section 079200 “Joint Sealants”.
 - 5. Section 089000 “Louvers and Vents”

1.3 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product indicated.
 - 1. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.
 - 1. Include building elevations showing layout of units and locations of joints and anchors.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Qualification Data: For manufacturer.
- C. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing.
 - 1. Provide test reports based on testing within previous two years.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Manufacturer Qualifications: A qualified manufacturer of cast 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 Architectural Precast Association or the Precast/Prestressed Concrete Institute for Group A, Category AT.
- C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- D. Source Limitations for Cast Stone: Obtain cast stone units through single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.
- C. 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 cast stone 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.

1.7 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 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 cast stone has dried, but no fewer than seven days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 CAST STONE MATERIALS

- A. General: Comply with ASTM C 1364, Cast Stone Institute Technical Manual, and the following:
 - B. Portland Cement: ASTM C 150, 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; 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, gradation and colors as needed to produce required cast stone textures and colors.
 - E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
 - F. Admixtures: Use only admixtures specified or approved in writing by Architect.
 1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
 2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
 3. Air-Entraining Admixture: ASTM C 260. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.
 4. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 5. Water-Reducing, Retarding Admixture: ASTM C 494/C 494M, Type D.
 6. Water-Reducing, Accelerating Admixture: ASTM C 494/C 494M, Type E.
 - G. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M, Grade 60. Use epoxy-coated reinforcement.
 1. Epoxy Coating: ASTM A 775/A 775M.
 - H. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, Type 304.

2.2 CAST STONE UNITS

- A. Provide cast stone units complying with ASTM C 1364 using either the vibrant dry tamp or wet-cast method.
 - 1. Provide units that are 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.
- B. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
 - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 - 3. Provide drips on projecting elements unless otherwise indicated.
- C. Fabrication Tolerances:
 - 1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
 - 2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
 - 3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
 - 4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.
- D. Cure units as follows:
 - 1. Cure units in enclosed moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
 - 2. Keep units damp and continue curing to comply with one of the following:
 - a. No fewer than five days at mean daily temperature of 70 deg F or above.
 - b. No fewer than six days at mean daily temperature of 60 deg F or above.
 - c. No fewer than seven days at mean daily temperature of 50 deg F or above.
 - d. No fewer than eight days at mean daily temperature of 45 deg F or above.
- E. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- F. Colors and Textures: As selected by Architect from manufacturer's full range.

2.3 MORTAR MATERIALS

- A. Provide mortar materials that comply with Section 042113 "Brick Masonry."

2.4 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666.

- B. Dowels: 1/2-inch- diameter, round bars, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666.

2.5 MORTAR MIXES

- A. Comply with requirements in Section 042113 "Brick Masonry" for mortar mixes.

2.6 SOURCE QUALITY CONTROL

- A. Engage a qualified independent testing agency to sample and test cast stone units according to ASTM C 1364.
 - 1. Include one test for resistance to freezing and thawing.

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 work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING CAST STONE IN MORTAR

- A. Install cast stone units to comply with requirements in Section 042113 "Brick Masonry."
- B. Set cast stone as indicated on Drawings. 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 cast stone 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 3/8 inch wide unless otherwise indicated.
 - 2. Build anchors and ties into mortar joints as units are set.
 - 3. Fill dowel holes and anchor slots with mortar.
 - 4. Fill collar joints solid as units are set.
 - 5. Build concealed flashing into mortar joints as units are set.
 - 6. Keep head joints in coping and other units with exposed horizontal surfaces open to receive sealant.
 - 7. Keep joints at shelf angles open to receive sealant.

- E. Rake out joints for pointing with mortar to depths of not less than 3/4 inch. 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. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- G. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- H. Provide sealant joints at copings and other horizontal surfaces, at expansion, control, and pressure-relieving joints, and at locations indicated.
 - 1. Keep joints free of mortar and other rigid materials.
 - 2. Build in compressible foam-plastic joint fillers where indicated.
 - 3. Form joint of width indicated, but not less than 3/8 inch.
 - 4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
 - 5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- B. Variation from Level: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warpage of units within tolerances specified.

3.4 ADJUSTING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

END OF SECTION 047200

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Grout.
- B. Related Requirements:
 - 1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for Architecturally Exposed Structural Steel.
 - 2. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications and other steel items not defined as structural steel.
 - 3. Section 066100 "Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels".
 - 4. Section 052100 "Bearing Pads".

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges." All non-visible steel (not exposed to view) to the public is to be hot-dip galvanized Structural Steel Framing. Includes all platform support 'interior' steel.
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
 2. Welded built-up members with plates thicker than 2 inches.
 3. Column base plates thicker than 2 inches
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.
- 1.4 COORDINATION
- A. Coordinate installation of 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.
- 1.5 ACTION SUBMITTALS
- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product.
- 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. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 5. Identify members and connections of the Seismic-Load-Resisting System.
 6. Indicate locations and dimensions of protected zones.
 7. Identify demand critical welds.
- D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint [whether prequalified or qualified by testing], including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand critical welds.
- E. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Qualification Data: For Installer, fabricator, professional engineer and testing agency.
- C. Welding certificates.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Nonshrink grout.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- D. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 341 and AISC 341s1.
 - 3. AISC 360.
 - 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.8 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 corrosion and deterioration.

1. 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.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided General Contractor's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.
- C. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
1. Select and complete connections using schematic details indicated and AISC 360.
 2. Use Allowable Stress Design; data are given at service-load level.
- B. Moment Connections: Type PR, partially restrained.
- C. Construction: Moment frame.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M, Grade 50.
- B. Channels and Angles: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Type E, Grade B.
1. Weight Class: Standard
 2. Finish: Black.
- F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1 [**round**] head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain.
- C. Headed Anchor Rods: ASTM F 1554, Grade 55, weldable, straight.
 - 1. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 4. Finish: Plain.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, 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 greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate 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 unless noted as slip critical.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 GALVANIZING

- A. Hot-Dip Galvanized Finish (All Structural Steel Framing): Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: General Contractor shall procure services of qualified independent testing and inspecting agency to conduct the required testing.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M 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 are not accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- 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.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates and leveling plates: Clean concrete- and masonry-bearing surfaces of bond-reducing 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. Weld plate washers to top of baseplate.
 3. Snug-tighten or pretension 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.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. 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 within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are 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. Do not use thermal cutting during erection.
- G. Do not enlarge unfair 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 unless noted as slip critical.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: General Contractor shall procure services of qualified independent testing and inspecting agency to conduct the required testing.
- B. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M 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 are not accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.
- B. Touchup Painting: Cleaning and touchup painting are specified in Section 099600-"High Performance Coatings."

END OF SECTION 051200

SECTION 051213 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

A. Section Includes:

- 1. Structural Steel.

B.

- 1. Section 051200 "Structural Steel Framing" for adjoining structural steel.
- 2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.
- 3. Section 066100 "Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels".
- 4. Section 099600 "High-Performance Coatings" for surface preparation and priming requirements.
- 5. Section 052100 "Bearing Pads".

1.3 DEFINITIONS

- A. AESS: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents. All visible steel (exposed to view) to the public is to be AESS with a high-performance coating. Includes all platform support perimeter steel (full length of members if only a portion is exposed).

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of 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.

1.6 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.
 - 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. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation of bolt heads.
 - 5. Indicate exposed surfaces and edges and surface preparation being used.
 - 6. Indicate special tolerances and erection requirements.
- C. Samples: Submit Samples of AESS to set quality standards for exposed welds.
 - 1. Two steel plates, 3/8 by 8 by 4 inches, with long edges joined by a groove weld.

1.7 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Qualification Data: For Installer and fabricator.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling to prevent twisting, warping, nicking, and other damage. 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 corrosion and deterioration.

1. 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.
- B. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.9 FIELD CONDITIONS

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 1. Finish: Plain.

2.2 FILLER

- A. Filler: Polyester filler intended for use in repairing dents in automobile bodies.

2.3 PRIMER

- A. Primer: Comply with Section 099600 "High-Performance Coatings."

2.4 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
- B. In addition to special care used to handle and fabricate AESS, comply with the following:
 1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
 2. Grind sheared, punched, and flame-cut edges of AESS to remove burrs and provide smooth surfaces and edges.
 3. Fabricate AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
 4. Fabricate AESS with exposed surfaces free of seams to maximum extent possible.

5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
 6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
 7. Fabricate AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 8. Seal-weld open ends of hollow structural sections with 3/8-inch closure plates for AESS.
- C. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.
1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of 20 feet under any lighting conditions.
 2. Tolerances for walls of hollow steel sections after rolling shall be approximately 1/2 inch.
- D. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch with a tolerance of 1/32 inch for AESS.
- E. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate 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.

2.5 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 unless noted as slip critical.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:
1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
 2. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
 3. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where AESS is exposed to weather.
 4. Provide continuous welds of uniform size and profile where AESS is welded.
 5. Grind butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus zero inch for AESS.

6. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for AESS.
7. At locations where welding on the far side of an exposed connection of AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
8. Make fillet welds for AESS oversize and grind to uniform profile with smooth face and transition.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. 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 AESS 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. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.

3.3 ERECTION

- A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 1. Erect AESS to the tolerances specified in AISC 303 for steel that is designated AESS.

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 unless noted as slip critical.

2. Orient bolt heads in same direction for each connection and to maximum extent possible in same direction for similar connections.
- B. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.
1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for AESS.
 2. Remove erection bolts in AESS, fill holes, and grind smooth.
 3. Fill weld access holes in AESS and grind smooth.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: General Contractor shall procure services of a qualified independent testing and inspecting agency to conduct the required testing. The testing agency is not responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

3.6 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Touchup Painting: Cleaning and touchup painting are specified in Section 099600-"High Performance Coatings."

END OF SECTION 051213

SECTION 051300 - RETRACTABLE PLATFORM EDGE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 DESCRIPTION

1. This Section includes specifications for designing, furnishing and installing a complete Retractable Platform Edge system with Detectable Warning Strip, fabricated in eight (8) foot modules where possible with alternate lengths as necessary due to varying composite platform panel widths, along the new high-level platforms, as shown on the Contract Drawings.
2. The Contract Drawings show the general arrangement and basic details for the Retractable Platform Edge system. The drawings are not intended to show all design and dimensional details. It shall be the Contractors responsibility to produce final design documents and to perform design calculations. The final installation and operational integrity of the design shall be the sole responsibility of the Contractor.
3. The purpose of the Retractable Platform Edge is to provide additional clearance for wide bodied freight trains. When such a train is scheduled to pass through the station the retractable edge will be raised manually, section by section, to increase the clearance from 5'-7" to 6'-6", measured to the track center line on tangent track.
4. Each section of retractable platform edge must include provisions for locking in both the open and closed positions. To keep the retractable platform edge panels in the open position, a stainless steel pin (Type 316) on a chain must be attached to the panels adjacent to each angle tab, which would be inserted through a hole in the angle tab at each panel. To keep the panels in the down position, only the end panels need to be pad-locked due to the shiplap design which does not allow the panels to be raised individually. They must be raised in order, so the end panel must be raised first. There can be a stainless pin on a chain attached to the panel instead of a loose piece of rebar.

1.3 RELATED WORK SPECIFIED ELSEWHERE

1. Section 066400 “Polyethylene Platform Edge Units”.
2. Section 066100 “Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels”.
3. Section 321743 “Snow Melt Heating Panels”.

1.4 QUALITY ASSURANCE

1. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01. **This is a sole source item and no substitutions will be allowed.**
2. References:
 1. Aluminum Association (AA) Specification for Aluminum Structures.
 2. American Institute of steel Construction (AISC).
 3. American Railway Engineering Association (AREA) Manual, Chapter 15.
 4. American Society for Testing and Materials (ASTM)
 1. A 36 Structural Steel.
 2. A 588 High Strength Low-Alloy Structural Steel.
 3. A 276 Stainless and Heat-Resisting Bars and Shapes.
 4. B 209 Aluminum and Aluminum Alloy Sheet and Plate.
 5. B 210 Aluminum Alloy Drawn Seamless Tubes.
 6. B 308 Aluminum Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded.
 7. F 593 Stainless Steel Bolts, Hex Cap Screws, and Studs.
 8. F 594 Stainless Steel Nuts.
3. Manufacturer Qualifications:
 1. Employ welders, who have been qualified previously by the test as described in the American Welding Society's Standard D.1.1 Structural Welding code, to perform welding. Furnish certification that each welder has passed the test.
 2. At the Architect’s discretion, the Manufacturer's facility shall be inspected and approved by the Architect before commencing manufacturing operations. The Contractor shall notify the Construction Manager, in writing, at least 2 weeks prior to the start of manufacturing operation. All manufacturing operations shall be conducted by the approved manufacturer at the approved facility.3. The Manufacturer shall provide certified test data to demonstrate that their

Retractable Platform Edge system meets all of the Product Requirements stipulated in Part 2 of this Specification.

4. The Manufacturer shall provide the Contractor and Amtrak personnel training on the proper operation of the retractable platform edge panels.
4. Tolerances:
 1. Manufacture Tolerances:
 1. Flatness: 1/8 inch in eight feet.
 2. Hinge Alignment: 1/16 inch in eight feet.
 3. Fabrication: $\pm 1/8$ inch.
 4. Machined parts: $\pm 1/16$ inch or less as required for hinge components.
 2. Installation Tolerances:
 1. Vertical variation from embedded metal angle at back of Retractable Platform Edge shall not exceed 1/8 inch.
 2. Horizontal clearance from embedded metal angle at back of Retractable Platform Edge shall be 1/8 inch to 1/4 inch.
 3. Vertical variation between platform sections shall not exceed 1/8 inch at platform edge.

1.5 SUBMITTALS

1. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
2. Design Calculations: The Contractor shall submit five sets of design calculations, signed and sealed by a Professional Engineer licensed in Connecticut. Design calculations shall comply with the requirements of these Specifications. No work shall start prior to approval of the design calculations and shop drawings.
3. Shop Drawings and Installation Drawings:
 1. Submit shop drawing showing complete information for the manufacture and fabrication of the Platform Retractable Edge. Indicate member materials and dimensions, cross sections, details of all components and fasteners, welding and finishing requirements. Indicate module weight and lifting force at leading edge.
 2. Shop drawings shall include a numbered module layout for erection purposes. They shall include the horizontal and vertical alignment of the platforms as shown in the Contract Drawings. The shop drawings shall also reflect all information needed to erect the Platform Retractable edge including the shape and dimensions of modules, the size and details of the joint, the size of leveling shims, and any additional details necessary pertaining to installation.

3. Provide complete details of plates, sleeves or anchorage devices that are to be embedded in the composite transit platform panels.
4. Pre-Production Modules: The manufacturer shall fabricate at least three eight foot modules and completely assemble them on mock-up composite transit platform panels at their facilities so as to adequately demonstrate to the satisfaction of the Architect, installation and set-up procedures, conformance to required tolerances, satisfactory operation and final appearance. Any design or fabrication defect shall be corrected on the Pre-Production Modules to the satisfaction of the Architect, prior to manufacture and delivery of production units.
5. Installation Schedule: Prior to installation of any unit, submit a schedule indicating the sequence of installation of the modules and anchoring system.

1.7 EXTRA STOCK

- A. Submit the following in accordance with form 817 Article 1.20-1.08.14, NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS for additional information.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Retractable Platform Edge Units: 4 full-length 4' sections.

1.8 CLOSEOUT SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Manufacturer's Data:
 1. Submit three copies of manufacturer's specifications and product data for all manufactured materials and products. Include manufacturer's certifications and laboratory reports as required.
 2. Include erection procedure for attachment to pre-engineered composite platform panel units, sequence of erection, and required handling equipment. Indicate that copy of each instruction has been transmitted to the erector.

1.9 DELIVERY, STORAGE AND HANDLING

1. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

2. Pack fabricated modules and components in a manner to avoid damage from handling, shipping and storage after leaving factory.
3. Examine all parts of the supporting structure and the conditions under which the composite transit platform work is to be erected. Do not proceed with the installation until unsatisfactory conditions have been corrected.
4. Verify dimensions of supporting structure at the project Site and adjust final shop drawings to reflect actual field dimensions.
5. Design modifications may be made only as necessary to meet field conditions and ensure proper fitting of work, and only as approved by the Engineer in writing.

1.10 DESIGN CRITERIA

1. Minimum design loads shall be:
Dead Load: Material Weight
Live Load: 150 PSF
Snow: 30 PSF or Snow Drift
Wind: As per IBC Code
SEISMIC: Seismic performance category-B
2. Design Concept shall conform to Contract Drawings.
3. Comply with AISC Specifications for design, fabrication & installation.

1.11 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Furnish five (5) year manufacturer's warranty for defects in workmanship and materials.
- C. Furnish ten (10) year manufacturer's extended warranty against structural fatigue, corrosion and failure of manual operation parts and components.
- D. Repair or replace any portion of retractable platform edge that fails during the manufacturer's extended warranty period at no additional cost to CTDOT, including labor to remove failed section(s) and install replacement section(s).
- E. The Manufacturer shall furnish and install replacement parts and assemblies for a period of at least ten (10) years.

- F. The Manufacturer shall retain jigs, gauges and other equipment utilized in the fabrication of the approved units for a period of at least ten (10) years.

PART 2 - PRODUCTS

2.1 RETRACTABLE PLATFORM EDGE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01
- B. Available Manufacturer:
 - 1. ArmorDeck, as manufactured by Engineered Plastics, Inc., 300 International Dr., Williamsville, NY 14221, 800-682-2525. **This is a sole source item and no substitutions will be allowed.**
- C. Blocking material, bolted to pre-engineered reinforced composite transit platform panels to hold retractable platform edge modules level, shall be a non-absorbent, slightly resilient neoprene material that will not deteriorate with time or as a result of contact with chlorides. The material, and degree of resilience, shall be subject to assessment during review of the Pre-Production Modules and approved by the Architect.

2.2 DETECTABLE TACTILE WARNING SYSTEM

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Available Manufacturer:
 - 1. The Vitrified Polymer Composite (VPC) Surface Applied Tactile Tiles specified and shown on plans is based on “Armor-Tile” manufactured by Engineered Plastics, Inc., 300 International Dr., Williamsville, NY 14221, 800-682-2525. **This is a sole source item and no substitutions will be allowed.**

2.3 HEATING (SNOW, ICE AND FROST MELTING) SYSTEM

- A. Refer to Section 321743 “Snow Melt Heating Panels”

PART 3 - EXECUTION

3.1 INSPECTION

- 1. Inspect the installed work of other trades and verify that such work is complete to the point where this work may properly commence.
- 2. Conduct a coordinated test with Amtrak to ensure proper operation and clearance of the retractable platform edge is provided with an Amtrak train.

3.2 PREPARATION

- 1. Field Measurements: Verify measurements in field before fabrication.

3.3 ERECTION

1. Provide suitable temporary braces and stays to hold guardrails and metal fabrications in position until permanently secured.
2. Draw threaded bolt connections up tight with lock washers or other means to prevent loosening. Screw fasteners in exposed or finished surfaces must be vandal-proof type.
3. Lubricate all moving parts with an approved high retention grease.

END OF SECTION 051300

SECTION 052100 – BEARING PADS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bearing pads.
 - 2. Anchor bolts.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for additional requirements for structural steel.
 - 2. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.

1.3 DEFINITIONS

- A. Elastomer: The elastomeric compound used in the construction of the bearings.
- B. Steel Laminates: The internal steel used for reinforcement.

1.4 COORDINATION

- A. Coordinate installation of 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.

1.5 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product.
- C. Shop Drawings: Show fabrication of bearing pad components.
 - 1. Include complete details of bearings
 - 2. Include material designations.
 - 3. Include nominal hardness of elastomer
 - 4. Quantity of bearings required, including test bearings
 - 5. Location of the bearing identification.

1.6 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Qualification Data: For Installer, fabricator, professional engineer and testing agency.
- C. Mill test reports for steel laminates, including chemical and physical properties.
- D. Product Test Reports: For the following:
 - 1. Anchors and nuts including mechanical properties and chemical analysis.
 - 2. Elastomer

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- C. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep bearing pads off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect bearing pads and packaged materials from corrosion and deterioration.
 - 1. 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.

- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1554 fasteners and for retesting fasteners after lubrication.
- C. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Bearings are to satisfy the requirements of AASHTO Standard Specifications for Highway Bridges, Division II – Construction and those set forth in Form 817 Article 1.06.07.

2.2 BEARING MATERIALS

- A. Steel laminates: Mild rolled steel, ASTM A570, Grade 36 or 40, ASTM A611 Grade C or D, or an approved equal.
- B. Elastomer: Low temperature grade 3, Shore "A" Durometer hardness

2.3 ANCHORS

- A. Bolts and Nuts: ASTM F1554, Grade 105, anchor bolts and nuts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; all to be galvanized in accordance ASTM A153.

2.4 FABRICATION

- A. Bearing Pads: Fabrication and tolerances to be to the requirements of AASHTO Standard Specifications for Highway Bridges, Division II - Construction.

2.5 GALVANIZING

- A. Galvanized Finish: Anchor bolts and nuts to be galvanized according to ASTM A153.

2.6 SOURCE QUALITY CONTROL

- A. Testing Agency: General Contractor shall procure services of a qualified independent testing and inspecting agency to conduct the required tests and inspections.

1. Provide testing agency with access to places where bearing pads are being fabricated or produced to perform tests and inspections.
- B. Testing Agency: The materials for the elastomeric bearing and the finished bearings themselves shall be subjected to testing. The testing shall conform to the requirement of the AASHTO Standard Specifications for Highway Bridges, Division II – Construction.
- C. Certification: The Contractor shall furnish a Certified Test Report, confirming that the elastomeric bearing, satisfy the requirement of these specifications, in conformance with the requirements set forth in Form 817 Section 1.06.07.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of concrete-, steel-, and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Bearing areas, upon which the elastomeric bearings will be set, shall be cleaned of all debris. Bearing areas shall be carefully finished, by grinding, if necessary, to smooth, even, level surface of the required elevation, and shall show no variations from a true plane greater than 1/8 inch over the entire area upon which the elastomeric bearing is to rest.

3.3 ERECTION

- A. Set bearing pads accurately in locations and to elevations indicated.
- B. The elastomeric bearings shall be installed as shown on the plans. The elastomeric bearing shall be installed when the temperature of the ambient air and the bearing is between 40°F to 85°F.

3.4 FIELD QUALITY CONTROL

- A. General Contractor shall procure services of a qualified independent testing and inspecting agency to conduct the required tests and inspections.

3.5 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.
- B. Touchup Painting: Cleaning and touchup painting are specified in Section 099600-"High Performance Coatings."

END OF SECTION 052100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof framing.
- B. Related Sections:
 - 1. Section 072100 "Thermal Insulation".
 - 2. Section 104116 "Emergency Key Cabinet".

1.3 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of cold-formed steel framing product and accessory.
- C. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- D. Delegated-Design Submittal: For cold-formed steel framing.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Qualification Data: For testing agency and professional engineer.
- C. Welding certificates.
- D. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Horizontal drift deflection clips
 - 7. Miscellaneous structural clips and accessories.
- E. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.
- B. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Craco Mfg., Inc.
 2. ClarkDietrich Building Systems.
 3. MarinoWARE.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer licensed in the State of Connecticut to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: As indicated.
 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height.
 - b. Roof Framing: Vertical deflection of 1/240 of the horizontally projected span for live loads.
 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
 4. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Design Standards:
1. Floor and Roof Systems: AISI S210.
 2. Wall Studs: AISI S211.
 3. Headers: AISI S212.
 4. Lateral Design: AISI S213.
- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
 2. Coating: Minimum of G90 or equivalent for masonry veneer stud backup applications. Minimum of G60, A60, AZ50, or GF30 for all other applications.
- B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
1. Grade: As required by structural performance.
 2. Coating: G60.

2.4 ROOF FRAMING

- A. Steel Roof Framing: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0538 inch.
 2. Flange Width: 1-5/8 inches, minimum.

2.5 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Anchor clips.
 5. End clips.
 6. Foundation clips.
 7. Gusset plates.
 8. Stud kickers and knee braces.
 9. Joist hangers and end closures.
 10. Hole reinforcing plates.
 11. Backer plates.

2.6 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or

equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.
- C. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.8 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing 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 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
 - 4. Connect drift clips to cold-formed metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - a. Install solid blocking at 96-inch.
 - 2. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

- A. Testing: General Contractor shall procure services of a qualified independent testing and inspecting agency to conduct the required field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 – 2016, and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel framing and supports for electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 3. Miscellaneous steel trim.
 - 4. Loose bearing and leveling plates.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Loose steel lintels.
 - 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
- C. Related Sections:
 - 1. Section 099600 “High Performance Coatings” for loose steel lintels.
 - 2. Section 066000 “Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels”.
 - 3. Section 042113 “Brick Masonry”.
 - 4. Section 042200 “Concrete Unit Masonry”.
 - 5. Section 051200 “Structural Steel Framing”.
 - 6. Section 051213 “Architecturally Exposed Structural Steel Framing”.

1.3 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.4 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Qualification Data: For qualified professional engineer.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- E. Product Test Reports: For the following:
 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 2. Shop primers.
 3. Nonshrink grout.
- F. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication. When shop drawings are submitted

based on field measurements those field measurements shall also be submitted for the Engineer's use.

1.8 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. 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.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 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.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 316L.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L.
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- F. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- G. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
- 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. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 2.
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Eyebolts: ASTM A 489.
- G. Machine Screws: ASME B18.6.3.
- H. Lag Screws: ASME B18.2.1.
- I. Wood Screws: Flat head, ASME B18.6.1.
- J. Plain Washers: Round, ASME B18.22.1.
- K. Lock Washers: Helical, spring type, ASME B18.21.1.
- L. Anchors, General: Anchors capable of sustaining, 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.
- M. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- N. Post-Installed Anchors: chemical anchors.
 - 1. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- E. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 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 value 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 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 contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners 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.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 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.
 - 1. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

2.7 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 where indicated.
- D. Prime miscellaneous steel trim with primer specified in Section 099600 "High-Performance Coatings."

2.8 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 where indicated.
- C. Prime plates with primer specified in Section 099600 "High-Performance Coatings."

2.9 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. Fabricate in single lengths for each opening unless otherwise 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. Hot-dipped galvanized loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with primer specified in Section 099600 "High-Performance Coatings."

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 no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.11 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with primers specified in Section 099600 "High-Performance Coatings".
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2.13 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).
- C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

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 screws, 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.

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.

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 nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings".
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 – 2016, and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel railings.
 - 2. Stainless-steel pipe railings.
 - 3. Incorporated systems, sign frames, brackets and fasteners
- B. Related Sections:
 - 1. Section 066100 “Structural reinforced Modular Polymer Composite Deck and Surface-Applied Panels”.
 - 2. Section 099600 “High Performance Coatings”.
 - 3. Section 104250 Site Wayfinding & Identification Signage”.

1.3 PERFORMANCE REQUIREMENTS

- A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 60 percent of minimum yield strength.
 - 2. Stainless Steel: 60 percent of minimum yield strength.
- B. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
 - C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
 - D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- 1.4 ACTION SUBMITTALS
- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
 - B. Product Data: For the following:
 1. Manufacturer's product lines of mechanically connected railings.
 2. Railing brackets.
 3. Grout, anchoring cement, and paint products.
 - C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - D. Samples for Verification: For each type of exposed finish required.
 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 2. Fittings and brackets.
 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
 - B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
 - C. Welding certificates.
 - D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. 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.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.2 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.3 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 316L.
- B. Pipe: ASTM A 312/A 312M, Grade TP 316L Extra Strong.
- C. Castings: ASTM A 743/A 743M, Grade CF 8M or CF 3M.
- D. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316L.
- E. Handrail Brackets: Provide stainless steel post-mount handrail brackets capable of mechanical attachment to posts.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Wagner, R & B, Inc.; a division of the Wagner Companies (Model # MB3301P with 2 5/8" offset)
 - b. Approved Equal.

2.4 FASTENERS

- A. General: Provide the following:
 - 1. Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
 - 2. Stainless-Steel Railings: Type 316 stainless-steel fasteners.
- B. Post-Installed Anchors: chemical anchors capable of sustaining, 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 Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."
- C. Intermediate Coats and Topcoats: Provide products that comply with Section 099600 "High-Performance Coatings."
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 1. Water-Resistant Product: Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. 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.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

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 flux immediately.
 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- J. Form changes in direction as follows:
1. As detailed.
- K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of railing members with prefabricated end fittings.
- M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.7 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.

2.8 STEEL AND IRON FINISHES

- A. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry, unless otherwise noted on drawings.
 1. Preparation for Shop Priming: Surface Preparation for Exterior Exposed Structural Steel: Systems include exterior platform railings and incorporated systems, sign frames, brackets and fasteners. Prepare steel to SSPC-SP 10 "Near White Blast Cleaning," and to the requirements listed in Section 099600 – "High Performance Coatings".

- B. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - 1. Shop prime uncoated railings with primers specified in Section 099600 "High-Performance Coatings".
- C. Shop-Painted Finish: Comply with Section 099600 "High-Performance Coatings."
 - 1. High-Performance Coating: Apply coatings as specified in Section 099600 "High-Performance Coatings".

2.9 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines, or blend into finish.
- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- C. Directional Satin Finish: No. 4.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide 3 ¾" long slip-joint internal connectors with set screws for 2" Schedule 40 pipe. Wagner, Model #3325, or approved equal.

3.3 ANCHORING POSTS

- A. Anchor posts to surfaces with flanges connected to posts and to supporting members as follows:
 - 1. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
 - 2. For steel pipe railings, weld flanges to post and bolt to supporting surfaces.

3.4 ADJUSTING AND CLEANING

- A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."

3.5 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 061063 - EXTERIOR ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous wood nailers, furring and blocking.
 - 2. Framing with dimensional lumber.
- B. Related Sections:
 - 1. Section 061600, "Sheathing".
 - 2. Section 077100 "Roof Specialties".
 - 3. Section 074293 "Soffit Panels"
 - 4. Section 074650 "Exterior Siding and Trim".
 - 5. Section 076200 "Sheet Metal Flashing and Trim".

1.3 DEFINITIONS

- A. Boards: Lumber of less than 2 inches nominal in thickness and 2 inches nominal or greater width.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- C. Timber: Lumber of 5 inches nominal or greater in least dimension.
- D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. RIS: Redwood Inspection Service.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Material Certificates:
 - 1. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.
- C. Certificates of Inspection: Issued by lumber grading agency for exposed wood products not marked with grade stamp.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.
- C. Handle and store plastic lumber to comply with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

- A. Lumber: Comply with DOC PS 20 and with 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 ALSC's Board of Review. Provide lumber graded by an agency certified by ALSC's Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each item with grade stamp of grading agency.
 - 2. For items that are exposed to view in the completed Work, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 DIMENSION LUMBER

- A. Maximum Moisture Content: 15 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal thickness.
- B. Exposed soffit: Provide material hand selected for freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot holes, shake, splits, torn grain, and wane, the following grade, species, and sizes:
 - 1. Grade; Select Structural.
 - 2. Doug Fir-Larch; WWPA.
 - 3. Sizes; as indicated on plans.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
 - 1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
 - 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 - 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. For all applications, use materials that comply with testing requirements after being subjected to accelerated weathering according to ASTM D 2898.
 - 2. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.
 - 3. All wood items are to receive a stained or natural finish. Use organic resin chemical formulation on all wood.
 - 4. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 - 5. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
 - 1. Use stainless steel unless otherwise indicated.
 - 2. For pressure-preservative-treated wood, use stainless-steel fasteners.
- B. Wood Screws: ASME B18.6.1.
- C. Stainless-Steel Bolts: ASTM F 593, Alloy Group 1 or 2; with ASTM F 594, Alloy Group 1 or 2 hex nuts and, where indicated, flat washers.

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 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Prime lumber to be painted, including both faces and edges. Cut to required lengths and prime ends. Comply with requirements in Section 099113 "Exterior Painting."

3.3 INSTALLATION, GENERAL

- A. Set exterior rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit exterior rough carpentry to other construction; scribe and cope as needed for accurate fit.
- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction" unless otherwise indicated.
- C. Install wood rafters with crown up.
- D. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- E. Secure decking to framing in a manner which conceals fasteners.
- F. Do not splice structural members between supports unless otherwise indicated.

- G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- H. 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.
- I. Comply with AWWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron (SBX) for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- J. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- K. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

END OF SECTION 061063

SECTION 061600 – SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof sheathing.
 - 2. Sheathing joint and penetration treatment.
- B. Related Sections:
 - 1. Section 061063, "Rough Carpentry" for plywood backing panels.
 - 2. Section 074113.13 “Formed Metal Roof Panels”.
 - 3. Section 073200 “Composite Roof Tile Systems”.
 - 4. Section 104116 “Emergency Key Cabinet”.

1.3 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 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.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. FM Global Listing: Provide sheathing and component materials that comply with Data Sheet 1-28. The sheathing within the following zones of the building should be designed to withstand an outward horizontal wind force of 46 psf in the field (Zone 4) and 46 psf in the corners (Zone 5) and an inward force of 49 psf in the field and 58 in the corners of the wall. Identify materials with FM Global markings.

2.2 WOOD PANEL PRODUCTS

- A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":
 - 1. Plywood.
 - 2. Oriented strand board.
- C. Plywood: DOC PS 1.
- D. Oriented Strand Board: DOC PS 2.
- E. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- F. Factory mark panels to indicate compliance with applicable standard.

2.3 ROOF SHEATHING

- A. Plywood Roof Sheathing: Exterior, Structural I sheathing as substrate board beneath standing seam metal roofing.
 - 1. Span Rating: Not less than 16/0.
 - 2. Nominal Thickness: Not less than 3/4 inch.
 - 3. Nominal Thickness (Historic Facility): Not less than 1/2 inch.

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 roof sheathing, provide fasteners of Type 316 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.

2.5 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 and ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

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. Arrange joints so that pieces do not span between fewer than three support members.
- 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."
 - 3. Table R602.3(1), "Fastener Schedule for Structural Members."
- D. Coordinate roof 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.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
- C. Fastening Methods: Fasten panels as indicated below:
 - 1. Roof Sheathing:

- a. Screw to cold-formed metal framing.
- b. Space panels 1/8 inch apart at edges and ends.

END OF SECTION 061600

SECTION 066100 – STRUCTURAL REINFORCED MODULAR POLYMER COMPOSITE DECK
AND SURFACE-APPLIED PANELS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.1 SUMMARY

- A. This Section includes the requirements for furnishing and installing all Heated Structural Reinforced Modular Polymer Composite Deck Panels and Stairs including transportation, tools, labor, material and equipment necessary to complete the work. The Contractor’s work includes but is not limited to the following:
 - 1. Supply and install Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels complete with Armor-Tile Detectable Tactile Warning Surface where applicable.
 - 2. Verify the location of the structural steel support system in the field.
 - 3. Locate all other items shown in the Construction Documents in order to determine the corresponding openings in the panels.
 - 4. Provide openings during fabrication in all panels as required.
 - 5. Verify in the field all dimensions, elevations and materials required for the installation of the composite deck panels and report to the Resident Engineer and Architect any discrepancy with the contract drawings and shop drawings approved prior to release of the composite deck panels fabrication.
 - 6. Determine quantities of panels and types to complete the work.
 - 7. Other appurtenant or related work, as specified herein, directed by the Engineer or as shown on the drawings.
 - 8. Other appurtenances or related work, as specified herein, or as directed by the Resident Engineer or as shown on the contract drawings.
- B. Related Sections:
 - 1. Section 033000 “Cast-In-Place Concrete” (provisions for power beneath Reinforced Modular Polymer Composite Surface-Applied Panels).
 - 2. Special Provision, Form 817 Section 0947003A “Bus Passenger Shelter”.
 - 3. Section 051200 “Structural Steel Framing” (platform substructure).

4. Section 051213 “Architecturally Exposed Structural Steel Framing” (platform substructure).
5. Section 051300 “Retractable Platform Edge” (factory installed on Structural Reinforced Modular Polymer Composite Deck Panels).
6. Section 055000 “Metal Fabrications”.
7. Section 055213 “Pipe and Tube Railings”.
8. Section 066400 “Polyethylene Platform Edge Units” (factory installed on Structural Reinforced Modular Polymer Composite Deck Panels and Retractable Platform Edge).
9. Section 079200 “Joint Sealants”.
10. Section 104060 “Trash/Recycling Receptacles”.
11. Section 273226 “Blue Light / Emergency Telephone (BL/ETEL) System
12. Section 321743 “Snow Melt Heating Panels” (for incorporation of heating panels in Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels).

1.3 DESIGN REQUIREMENTS

A. Design Loads:

1. Live Loads: 150 lbs/sq ft with deflection limited to 1/360 of span.
2. Dead loads: 25 lbs/sq ft, with deflection limited to 1/240 of span.
3. Uplift load of 30 psf.
4. H-5 vehicle loading plus impact

B. Design items with sufficient strength for handling stresses.

1.4 PERFORMANCE REQUIREMENTS

A. Freeze Thaw Resistance: ASTM C666, Pass (no change).

1.5 REFERENCES

- A. American Railway Engineering and Maintenance-of-Way Association (A.R.E.M.A) Manual for Railway Engineering.
- B. Latest BOCA National Building Code.
- C. Latest Manual of Steel Construction of the American Institute of Steel Construction.

1.6 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Submit in accordance with General Provisions for Construction.

- C. Shop Drawings: Indicate design load parameters, dimensions, adjacent construction, materials, thicknesses, fabrication details, required clearances, field jointing, tolerances, colors, finishes, methods of support, integration of structural, mechanical, and electrical components, and anchorages. All shop drawings shall indicate detailing fabrication and installation including but not limited to the following:
1. Structural Reinforced Modular Polymer Composite Deck Panels:
 - a. Panel dimension and cross-sections, location, size and type of reinforced composite internal flanges, tactile surface and slope(s) for drainage of rainwater.
 - b. Detail loose, cast-in and field hardware, inserts, connections and joints, including accessories and construction at openings in panels.
 - c. Locations and details of anchorage devices that are to be embedded in other construction. Furnish templates, if required, for accurate placement.
 - d. Shop Drawings for products specified showing fabrication details of the Structural Reinforced Modular Polymer Composite Deck Panel and Surface-Applied Systems; plans of panel placement and material to be used as well as outlining installation materials and procedures.
 - e. Material test reports from the Manufacturer's testing and inspection agency indicating that materials proposed for use of the Structural Reinforced Modular Polymer Composite Deck Panel and Surface-Applied Systems complete with Armor-Tile Detectable Tactile Warning Surface are in compliance with requirements and meet the properties indicated.
 - f. Electrical drawings detailing wiring types and layout, heater models and locations, connector types and locations and control and distribution panel components.
 - g. The Contractor shall verify all dimensions, grades and elevations in the field prior to the submission of drilled piers and shafts, and platforms' shop drawings and starting construction. The Contractor shall also verify grades and elevations of the tracks prior to the submission of platform shop drawings and starting construction. The Contractor shall submit shop drawings indicating the horizontal alignment and vertical profile of the proposed platforms and foundations and survey showing all existing and proposed grades and elevations of stair, ramps, sidewalks, curbs, asphalt pavement and top of rail for review.
- D. Detectable Tactile Warning Tile Surface System:
1. Manufacturer's literature of product and routine maintenance practices.
 2. Include laboratory test reports from a qualified independent testing laboratory.
- E. Product Information: Submit manufacturer's product information and test sheets for Non-slip Wearing Surface coating.
- F. Design calculations prepared and stamped by a professional engineer registered in the State of CT.
- G. Samples:

1. Submit color samples of all available color options for selection.
 2. Submit 12x12 inch finish samples of all available texture/finish options for selection.
 3. Submit two 24x24x7 1/8-inch panel mock-up samples of the color, texture, and finish selected by the Architect.
 4. Submit two 24x24x1/2-inch surface-applied panel mock-up samples of the color, texture, and finish selected by the Architect.
- H. Test Report: Test data demonstrating that the proposed materials and panels comply with the performance requirements specified in this Section, including a test report showing panels meets Class 1 flame spread requirements when tested in accordance with ASTM E84.
- I. Manufacturer's sample warranty.
- J. Maintenance Data: Include operation and maintenance manual.

1.6 CLOSEOUT SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS
- B. Submit in accordance with General Provisions for Construction.
- C. Operation and Maintenance Data: Submit instructions for cleaning and stain removal, applied restoration, inspection criteria, patching and routine repairs.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01. **This is a sole source item and no substitutions will be allowed.**
- B. Installer Qualifications: The Contractor shall engage an experienced Installer who has completed installation of Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels with Snow Melt Heating Panels, similar in material, design and extent to that indicated for this Project and with a five-year record of successful in-service performance.
 1. Installer shall have full knowledge of railroad restrictions for work on this project, and shall be equipped to handle all panel related materials on site. All site equipment shall remain clear of overhead electrical lines and shall be installed only during those time periods allowed in the contract documents.
 2. Equipment that can be extended to within 15'-0" of any overhead electrical

wire will require the wire to be de-energized and the adjacent track taken temporarily out of service.

3. A schedule of erection equipment and erection progress shall be submitted prior to the start of work.
- C. Manufacturer's Qualifications: Firm experienced in producing Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels similar to those indicated for this Project and with a record of successful in-service performance as well as sufficient production capacity to produce required units without delaying the work.
 1. The Manufacturer shall have a minimum of five (5) years of Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panel manufacturing experience plus personnel with a minimum of five (5) years cumulative direct supervisory experience in the manufacture of structural cast composite polymer products.
- D. Federal: "Americans with Disabilities Act"

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. Deliver, store, protect, and handle Products to site under requirements of General Provisions for Construction.
- C. Deliver panels to project site in such quantities and at such times to ensure continuity of installation. Accept units on site in factory packing. Inspect for damage.
- D. Store panels at project site in a location approved by Construction Manager, and prevent cracking, distorting, warping, staining, or other physical damage.
- E. Deliver anchorage items that are to be embedded in other construction before starting such work. Provide setting diagrams, templates, instructions and directions, as required, for installation.
- F. Protect Tactile Warning System Tiles against damage from rolling loads for initial period following installation by covering with plywood or hardboard, using dollies to move stationary equipment across planks.
- G. Cover tactile warning system tiles with undyed, untreated building paper or plastic until inspection and substantial completion. Ensure protective materials are adequately secured to prevent interference with train movements. Re-secure any loose, torn or similarly disabled protective covering immediately.

- H. Cover platform surface with building paper, wood or plastic in any area where work is being performed to prevent staining with paint, sealant, metal shavings, etc. until inspection and substantial completion.

1.10 PRE-INSTALLATION MEETING

- A. Pre-installation Conference: Conduct conference at Project site to comply with the requirements of the Conditions of the Contract and of Division 1 – General Requirements.

1.11 MOCKUP

- A. Construct mockup of a single panel section for both the Composite Deck Panel with snow melt and Surface-Applied Panel with snow melt that can be used in the final installation.
- B. Locate where directed by Construction Manager.
- C. Incorporate accepted mockup as part of Work.

1.12 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.
- B. Verify location and dimensions of steel substructure.

1.13 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels:
 - 1. Furnish twenty-five (25) year manufacturer's warranty against, structural fatigue, corrosion, spalling, or cracking. Any such panel that fails during the stipulated guarantee period shall be replaced or repaired at no additional cost to the Owner.
 - 2. Furnish ten (10) year manufacturer's warranty against excessive panel wear and surface finish.
- C. Snow Melt Heating Panels:
 - 1. Shall comply with Section 321743 “Snow Melt Heating Panels”.
- D. Repair or replace any panel that fails during the manufacturer's extended warranty period at no additional cost to CTDOT, including Rail Road Force

Account and labor to remove failed section and install replacement section.

- E. Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels with snow melt not conforming to requirements are unacceptable. Remove rejected panels and replace with panels conforming to requirements. Panels shall be considered potentially deficient if they fail to comply with specified requirements for strength, durability, manufacturing tolerances, curing and finishes; or are damaged during handling and erecting.

PART 2 PRODUCTS

2.1 STRUCTURAL REINFORCED MODULAR POLYMER COMPOSITE DECK PANEL SYSTEM

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01
 - 1. The Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panel System shall be “Armor-Deck Transit Platform and Composite Panel Systems with Armor-Tile Detectable Warning Tile System”, as fabricated by Engineered Plastics, Inc., 300 International Dr., Williamsville, NY 14221, 800-682-2525. **This is a sole source item and no substitutions will be allowed.**
- B. Platform panels shall be formed to accommodate the retractable edge system where indicated. This section shall be molded monolithically with the entire platform panel, but have a specific internal construction designed to meet the load factors of the retractable edge connections. Bolt holes for attachment of retractable edge hinges and blocks are to be molded into the panel. Drilled bolt holes in the panel are not acceptable as they do not provide the strength nor maintain the integrity of the composite panel as molded holes provide. Retractable edge rear angle to be factory installed on platform panels. Retractable edge panels are to be supplied by Structural Reinforced Modular Polymer Composite Deck Panel manufacturer and test fit to composite platform panels prior to shipment to job site.
- C. Structural Reinforced Modular Polymer Composite Deck standard panels shall have the following dimensions: length: up to 12’, width: 4’, depth: 7 1/8”.
- D. Limit deflection to 1/360 of span with 150 lbs./sq.ft. live load
- E. Limit deflection to 1/240 of span with 25 lbs./sq.ft. dead load
- F. Tensile Modulus of Elasticity: ASTM D638 - 570,000 psi
- G. Compressive Strength: ASTM C109 - 5,000 psi
- H. Freeze Thaw Resistance: ASTM C666 - pass (no change)
- I. Slip Resistance: ASTM C1028 - minimum 0.8

- J. Tensile Strength: ASTM C307 - minimum 1,200 psi
- K. Flexural Strength: ASTM C580 - minimum 1,000 psi

2.2 AGGREGATE DECK SURFACE

- A. Description: factory applied non-skid composite urethane, aggregate and epoxy surface finish meeting 2006 DOTAS coefficient of friction requirements. Samples to be submitted to Architect for approval.
- B. Manufacturer:
 - 1. Engineered Plastics, Inc., "Diamond-Tek".
- C. Description: non-skid polymer composite of urethane, aggregate and UV resistant epoxy resin having a minimum coefficient of friction of 0.8 as measured by ASTM C-1028.
- D. Sample to be approved by Architect for color and texture.
- E. Deck Surface to be warranted against wear and delamination for a period of 10 years.

2.3 ABRASIVE NOSINGS (AT STAIRS)

- A. Cast-Metal Units: 4" cast aluminum (Type 116), with concealed integral anchors. Fabricate units in lengths necessary to accurately fit as an integral part of the composite transit stairs.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide 4" Cast Aluminum Abrasive Stair Nosing by The Mat King, 3000 Hempstead Turnpike; Suite 301, Levitown, Long Island, NY 11756; (516) 501-0744 or (800) 442-6544, or approved equal.

2.4 CONNECTION MATERIALS AND FINISHES

- A. Galvanized steel: As provided by Structural Reinforced Modular Polymer Composite Deck Panel manufacturers.
- B. Bolts and studs: ASTM A307, Grade A (ASTM F568, Property Class 4.6); nickel-plated nuts; connecting rod; and flat, unhardened steel washers.
- C. Accessories: Provide required to install panels.

2.5 BEARING PADS

- A. Provide bearing pads for panels as follows:
 - 1. Elastomeric Pads: neoprene elastomer, molded to size or cut from a molded sheet, Durometer 60, Min. Tensile Strength: 1,000 p.s.i., Min. Ultimate Elongation: 300%.

2.6 DETECTABLE TACTILE WARNING SYSTEM

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
 - 1. The Vitrified Polymer Composite (VPC) Surface Applied Tactile Tiles specified and shown on plans is based on “Armor-Tile” manufactured by Engineered Plastics, Inc., 300 International Dr., Williamsville, NY 14221, 800-682-2525. **This is a sole source item and no substitutions will be allowed.**

2.7 HEATING (SNOW, ICE AND FROST MELTING) SYSTEM

- A. Refer to Section 321743 “Snow Melt Heating Panels”

2.8 FABRICATION

- A. Tooling: Accurately construct forms of sufficient strength to withstand pressures due to molding operations and temperature changes. Maintain formwork to provide completed panels, lines and dimensions indicated, within fabrication tolerances specified.
- B. Built-In Anchorages: Accurately position built-in anchorage devices and secure to formwork. Locate anchorages where they do not affect the position of the main reinforced composite internal flanges.
- C. Cast-in Openings: Openings larger than 5 inches in diameter or 5 inches square according to final shop drawings. Smaller holes may be field cut or drilled by trades requiring them without cutting reinforcement and if acceptable to Architect and Manufacturer.
- D. Top Surface Finish: The top surface of the panels shall be a factory applied non-skid aggregate infused wearing surface meeting ADA coefficient of friction requirements. Samples to be submitted to Architect for approval.
- E. Tolerances: Panel fabrication shall not exceed the following tolerance criteria:
 - 1. Panel length: $\pm 1/8$ inch
 - 2. Panel width: $\pm 1/8$ inch
 - 3. Panel squareness: 0.002 radians (2:1000)
 - 4. Panel camber: $\pm 1/8$ inch in length or width
 - 5. Panel thickness: $\pm 1/16$ inch
 - 6. Draft on sides and ends of panel: $\pm 1/16$ inch
- F. Finish Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels as follows:
 - 1. Finish along surfaces in contact with each other. Normal plant-run finish that produces an exposed surface smooth finish.
- G. Cleaning and Protection:
 - 1. Perform the following operations prior to shipping panels:
 - a. Sweep or vacuum top surface sections thoroughly.

- b. Clean tactile tiles, using rugged bristle broom and commercial detergent to remove marks or any residue. Flush clean with water.
 - c. Remove any excess grout or other surface blemishes using appropriate cleaner recommended by tactile tile manufacturer.
- H. Protect panels against damage during construction period to comply with detectable warning tiles manufacturer's directions.
 - 1. Protect detectable warning tiles against damage from rolling loads for initial period following installation by covering with plywood or hardboard, using dollies to move stationary equipment across planks.
 - 2. Cover detectable warning tiles with undyed, untreated building paper or plastic until inspection and substantial completion.
 - 3. Clean panel surface including detectable warning tiles not more than four (4) days prior to date scheduled for inspections intended to establish date or substantial completion in each area of project. Clean tiles by method recommended by the tile manufacturer.

2.9 PLANT QUALITY CONTROL EVALUATIONS

- A. General Contractor shall procure services of qualified independent testing and inspecting agency to conduct the required testing. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense. Inspectors will evaluate Structural Reinforced Modular Polymer Composite Panel manufacturer's quality control, testing methods and test results.
 - 1. Allow inspectors access to material storage areas, Structural Reinforced Modular Polymer Composite Panels production equipment, materials placement and curing facilities as needed to perform tests and inspections.
 - 2. Allow inspectors access to the Contractor's testing and inspection agency testing of the Structural Reinforced Modular Polymer Composite Panels.
 - 3. Cooperate with inspectors and provide samples of materials and other items as may be requested for additional testing and evaluation.
- B. Structural Reinforced Modular Polymer Composite and Surface-Applied Panels will be considered potentially deficient if they fail to comply with specified requirements, including, but not limited to the following:
 - 1. Test results fail to meet design strengths.
 - 2. Curing and protection of panels fail to meet requirements.
 - 3. Panels are damaged during handling and erecting.
- C. Structural Reinforced Modular Polymer Composite and Surface-Applied Panel Testing:
 - 1. Full scale load and material testing shall be performed by the Contractor's testing and inspection agency.

2. Uniform design load tests based on 125 pounds per square foot (live load = 100 pounds per square foot plus snow load = 25 pounds per square foot).
 3. Coefficient of friction/slip resistance test using standard test method ASTM C1028, the combined wet/dry static coefficient of friction not to be less than 0.80.
 4. When there is evidence that the strength or durability of panels may be deficient or may not meet requirements, inspectors will obtain, prepare and test samples obtained from completed Structural Reinforced Polymer Composite Panels to determine design strengths and to perform structural evaluation or other necessary analysis.
- D. Test results will be made in writing on the day that tests are conducted, with copies to Architect, Contractor and Manufacturer. Test reports will include the Project identification name and number, name of Structural Reinforced Modular Polymer Composite Panel fabricator, name of testing agency, name and identification of plank or panels represented by tests, test strengths, type of break and direction of applied load with respect to the top surface of panel.
- E. Dimensional Tolerances: Panels having dimensions smaller or greater than tolerance limits may be rejected.
1. Panels having dimensions outside the specified tolerances will be rejected if the appearance or function of the structure is adversely affected or if larger dimensions interfere with other construction.
 2. Repair or remove and replace rejected units, as required by Architect, to meet construction conditions.
- F. Defective Work: Panels not conforming to requirements, including strength, durability requirements, manufacturing tolerances and finishes, are unacceptable. Remove rejected panels and replace with panels conforming to requirements.
- G. Detectable Warning Tile System - material testing shall be performed by the Manufacturer's testing and inspection agency and comply with specified requirements.
1. Water Absorption of Tile when tested by ASTM D570 not to exceed 0.05%.
 2. Slip Resistance of Tile when tested by ASTM C1028 the combined wet and dry static coefficients of friction not to be less than 0.8 on top of domes and field area.
 3. Compressive Strength of Tile when tested by ASTM D695 not to be less than 25,000 psi.
 4. Tensile Strength of Tile when tested by ASTM D638 not to be less than 12,500 psi.
 5. Flexural Strength of Tile when tested by ASTM D790 not to be less than 25,000 psi.
 6. Chemical Stain Resistance of Tile when tested by ASTM D1308 to withstand without discoloration or staining - 10% hydrochloric acid, urine, saturated calcium chloride, black stamp pad ink, chewing gum, red aerosol paint, 10% ammonium hydroxide, 1% soap solution, turpentine, urea 5%, diesel fuel and motor oil.
 7. Fire Resistance of Tile when tested to ASTM E84 flame spread shall be less than 25.

8. Accelerated Weathering of Tile when tested by ASTM G155 for 2,000 hours shall exhibit the following result: $-\Delta E < 5$, as well as no deterioration, fading or chalking of surface of tile color No 33538.
9. Accelerated Aging and Freeze Thaw Test of Tile and Adhesive System when tested to ASTM D1037 shall show no evidence of cracking, delamination, warpage, checking, blistering, color change, loosening of tiles or other detrimental defects.
10. Salt and Spray Performance of Tile and Adhesive System when tested to ASTM B117 not to show any deterioration or other defects after 200 hours of exposure.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements, including installation tolerances, true and level bearing surfaces, and other conditions affecting performance of the panels.
- B. Verify substructure is ready to receive work and dimensions are as indicated on shop drawings. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's installation instructions.
- B. Structural Reinforced Modular Polymer Composite Deck Panels:
 1. Bearing pads: Install bearing pads as panels are being erected. Set pads on true, level and uniform bearing surfaces and maintain in correct position until panels are placed.
 2. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to panels, unless otherwise approved by Manufacturer.
 3. Install panels with 1/4" gap between panels to allow for expansion.
 4. Erection Tolerances: Install panels square and true, without exceeding the following tolerances:
 - i. Variations from level or elevation: 1/8" in any 20' run.
 - ii. Variation from position in plan: plus or minus 1/4" maximum at any location along the platform.
 - iii. Offsets in alignment of adjacent panels at any joint: 1/8" in any 10' run.
- C. Reinforced Modular Polymer Composite Surface -Applied Panels:
 1. Install panels between with gaps specified on manufacturer's shop drawings to allow for expansion.
 2. Erection Tolerances: Install panels square and true, without exceeding the following tolerances:

- i. Variations from level or elevation: 1/8" in any 20' run.
 - ii. Variation from position in plan: plus or minus 1/4" maximum at any location along the platform.
 - iii. Offsets in alignment of adjacent panels at any joint: 1/8" in any 10' run.
3. New concrete should cure for 28 days prior to tile installation.
 4. Surface must be structurally sound and free of voids, spalling and obtrusions or foreign matter. If obtrusions are present, use grinder and diamond cup wheel to remove.
 5. Locate and saw cut channels into substrate to accommodate heater cables or conduit.
 6. Vacuum the substrate surface. Surface shall be dry, free of voids, dust and oils prior to panel installation.
 7. Test fit all panels to ensure uniform connection to substrate surface around entire perimeter and heater cable clearance within channels.
 8. Using a 1/4"x 1/4" v-notched trowel, spread adhesive over entire surface to receive Armor Deck panels. Trowel should be held straight up, not on an angle to ensure uniform application and the correct amount of adhesive. Adhesive should also be spread into the saw cut channels.
 9. Note - adhesive is not to be used as leveler or filler and should not be used below 40 F degrees (various temperature/ adhesive options can apply).
 10. To ensure good bonding of the panel surface, the underside surface of each panel must be thoroughly wiped with acetone to remove all dust and oil residue from the manufacturing process. Clean the substrate surface with acetone. Acetone can also be used to clean any adhesive from the top panel surface.
 11. Drill anchor holes into substrate directly through channel around perimeter of panel. Stand as close as possible to pilot recessed areas on tile with both feet to insure dust from drilling does not collect under tile and creates void (using a vacuum system while drilling is advised).
 12. Mechanically fasten panels to substrate with SS anchoring system.
 13. Repeat steps H - K for each subsequent panel for remainder of panels, spreading of adhesive for more than 2 panels at a time is not advised.

3.3 CLEANING

- A. Clean exposed surfaces of planks after erection to remove markings, dirt and stains.

1. Wash and rinse according to Structural Reinforced Polymer Composite Deck and Surface-Applied Panel manufacturer's recommendations. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearances of exposed composite finishes.

3.4 PERFORMANCE REQUIREMENTS

- A. Conduct inspections, perform testing, and make repairs or replace unsatisfactory modular panel units as required.
- B. In addition to above, in-place modular panel units may be rejected for any one of the following reasons:
 1. Exceeding the specified installation tolerances.
 2. Irreparable damage during construction operations.
 3. Exposed to view surfaces which develop surface finish deficiencies.
 4. Non-compliance with acceptance criteria listed below.

3.3 ERECTION TOLERANCES

- A. Maximum Variation from Indicated Position: 1/8-inch.
- B. Maximum Offset from Alignment Adjacent Components: 1/8-inch.
- C. Maximum Variation from Level or Elevation: 1/8-inch in any 20' run.
- D. Maximum Offset in Alignment of Adjacent Panels at Joint: 1/16-inch in any 10' run.

3.4 GENERAL ACCEPTANCE CRITERIA

- A. Units shall meet specifications. No structural deficiencies, cracks, loose inserts or anchors, exposed steel, or other defects shall be permitted.
- B. Appearance Acceptance Criteria: When viewed at a distance of 10 ft. in natural daylight, exposed surfaces shall be uniform in color, texture, and finish shall be within the range of approved mock-up samples when compared side by side. Panel edges and details of decoration shall be clear, well defined and true to line within specified alignment tolerances. Following is a list of finish defects which are unacceptable and cause for rejection of panels:
 1. Ragged or irregular edges outside manufacturer's approved acceptance criteria.
 2. Non-uniformity of textures or color.
 3. Foreign material embedded in the face.
 4. Visible repairs.
 5. Visible cracks.
 6. Burns or other damage resulting from welding work.

- C. Composite Deck and Surface-Applied Panel units shall be reviewed for compliance with specifications in three stages as follows:
 - 1. Units will be inspected at fabrication plant.
 - 2. Units will be inspected after delivery to site.
 - 3. Units will be inspected after installation and final cleaning.
- D. Repair or replace units as directed by the Engineer.

3.5 CLEANING

- A. Clean exposed surfaces of planks after erection to remove markings, dirt and stains without damaging finished surface.
- B. Wash and rinse according to manufacturer's recommendations. Protect other work from staining or damage due to cleaning operations.
- C. Do not use cleaning materials or processes that could change the appearances of exposed composite finishes.

END OF SECTION 066000

SECTION 066400 – POLYETHYLENE PLATFORM EDGE UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 – 2016, and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Polyethylene Platform Edge Units and fasteners
- B. Related Sections:
 - 1. Section 051300 “Retractable Platform Edge”.
 - 2. Section 066100 “Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels”.

1.3 ACTION SUBMITTALS

- A. Submit product data for review and approval.
- B. Submit layout plan indicating unit dimensions, hole and groove spacing and dimensions, lengths of units, and fastening schedule.

1.4 EXTRA STOCK

- A. Submit the following in accordance with form 817 Article 1.20-1.08.14, NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS for additional information.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Rub Rail Units: 4 full-length pieces.
 - 2. Hardware: Adequate hardware for the replacement of four pieces.

1.5 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. The coefficient of thermal expansion in degrees Fahrenheit, tested in accordance with ASTM D696, shall not be greater than:
 - 1. 0 to 75 degrees: 1.1×10^{-4} inches per inch
 - 2. 75 to 120 degrees: 1.87×10^{-4} inches per inch
- C. Fabrication Tolerances:
 - 1. The straightness tolerance on the concrete edge side of the rubbing board shall be 1/8 inch in a ten foot section.
 - 2. The variation in width of the board shall not be more than 1/16 of an inch in any length section.
 - 3. The Contractor shall coordinate the location of fasteners with the factory-drilled holes in the units prior to fabrication.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store in compliance with manufacturer's written instructions.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify all dimensions of related construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 POLYETHYLENE PLATFORM EDGE UNITS

- A. Size and shape shall be as indicated on the Contract Drawings. The platform edge strip shall be fire-retardant ultra-high molecular weight polyethylene bar stock. The top surface shall be scarified to create a non-slip surface.
 - 1. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Units fabricated by Polymer Industries, 2926 South Steel, Tacoma, WA 98409, distributed by TriStar Engineered Plastic Solutions. Contact: Brian Parath, Branch Manager, TriStar Plastics Corp. telephone: 508.925.7409, bparath@tstar.com
 - b. Approved Equal.
 - 2. Cross Section Dimensions: As indicated on drawings.

3. Holes for Fastening: Provide factory-cut recessed holes and spline grooves as described in the contract drawings or as recommended by the manufacturer.
 4. Lengths: Fabricate product to match the width of structural reinforced modular polymer composite deck panels.
 5. Fasteners shall be Type 316 stainless steel.
 6. Exterior Surface: Non-yellowing, UV Stable surfaces all sides.
 7. Color: Safety Yellow.
 8. Dry Coefficient of Friction (traffic surface): 0.80
 9. Flammability: Flame Spread per ASTM E162-02: 35 Maximum Radiant Panel Index I_s .
 10. Smoke Generation per ASTM E662
 - a. Flaming Mode: Specific Optical Density D_s : 12 max., Maximum Specific Optical Density D_M : 430.
 - b. Non-Flaming Mode: Specific Optical Density D_s : 8 max., Maximum Specific Optical Density D_M : 246.
 - c. Smoke Toxicity per ASTM E800:
 - 1) Carbon Monoxide (CO): 123 ppm max.
 - 2) Hydrogen Flouride (HF): 1.5 ppm max.
 - 3) Hydrogen Chloride (HCl): 12 ppm max.
 - 4) Hydrogen Cyanide (HCN): 2 ppm max.
 - 5) Nitrogen Oxides (NO_x): 53 ppm max.
 - 6) Sulfur Dioxide (SO₂): 1 ppm max.
 - 7) Carbon Dioxide (CO₂): 10,000 ppm max.
- B. Sealant: Mildew-resistant, single-component, neutral-curing or acid-curing silicone sealant recommended by plastic manufacturer and complying with requirements in Section 079200 "Joint Sealants."
- C. Centering Splines: Use manufacturers recommended fiberglass centering splines and type 316 stainless steel screws as indicated in the drawings and as recommended by the manufacturer, whichever is more stringent.
- D. Anchor Bolts: The anchor bolts to be installed on the edge of Structural Reinforced Modular Polymer Composite Deck panels and Retractable Platform Edge panels for supporting the polyethylene platform edge units shall be 5/8" diameter ASTM 240 Type 316 stainless steel with washer, nut and nylon lock nut. Minimum of three (3) per panel.

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 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION, GENERAL

- A. Attach polyethylene platform edge strips at the structural reinforced modular polymer composite deck panel manufacturer's factory. Do not shim units.
- B. Install units true, straight, and plumb with no distortions.
- C. Attach polyethylene platform edge units to the structural reinforced modular polymer composite panels with approved Type 816 stainless steel, corrosion proof fasteners.
- D. Maintain uniform space between adjacent units and adjacent surfaces.

3.4 ADJUSTING, CLEANING AND REPLACEMENT

- A. Adjust units such that the top (traffic) edge is flush with the finished platform topping surface, within 1/16". Align individual pieces both horizontally and vertically within 1/16", with no more than 1/8" gap between pieces at butt joints.
- B. Adjust units to account for thermal expansion in the long direction of the unit. Cut units and install 1/8" gapped butt joints as required to prevent buckling of the units during expansions.
- C. Repair damaged and defective units to eliminate functional and visual defects; replace units where not possible to repair. Adjust joinery for uniform appearance.
- D. If units are struck by railroad traffic prior to substantial completion, the Contractor shall repair or replace the units to the Engineer's satisfaction at the Contractor's expense.
- E. Remove excess sealant and smears as units are installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.
- F. Clean units on exposed and semi exposed surfaces.

END OF SECTION 066400

SECTION 067413 - FIBERGLASS REINFORCED GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section includes glass-fiber-reinforced-plastic gratings, frames and structural support framing.

1.3 COORDINATION

- A. Coordinate installation of anchorages for gratings, grating frames, and structural support framing. 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.

1.4 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For glass-fiber-reinforced-plastic gratings and structural shapes.
- C. Shop Drawings: Include plans, sections, details and attachments to other work including; concrete station platform, guardrails and concrete support piers.
- D. Delegated-Design Submittal: For gratings and structural shapes, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

- B. The material covered by these specifications shall be furnished by an ISO-9001:2008 certified manufacturer of proven ability who is regularly engaged in the manufacture, fabrication and installation of FRP systems.
- C. Substitution of any component or modification of system shall be made only when approved by the Architect or Design Engineer.
- D. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Duragrid T-1700 2" T Bearing Bars Spaced 1.2" O.C. Gratings and Treads, as well as Structural Shapes and Plate as manufactured by Strongwell Corporation (508)468-8278; or approved equal.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer in the State of Connecticut to design gratings, treads and entire support structure.
- B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft. and maximum deflection of 1/4" at the center of simple span.
- C. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: 1.5.

2.3 GLASS-FIBER-REINFORCED-PLASTIC GRATINGS

- A. Pultruded Glass-Fiber-Reinforced Gratings and Stair Treads: Bar gratings 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 glass-fiber content.

1. Configuration: 2-inch T-bars spaced 1.2 inches o.c.
2. Resin Type: Polyester.
 - a. Flame-Spread Index: 25 or less when tested according to ASTM E 84.
3. Color: Gray.
4. Traffic Surface: Non-skid grit affixed to the surface by an epoxy resin followed by a baked-on top coat of epoxy resin.
5. Surface should have a Wear Index of less than 1.0 when tested to ASTM D4060 (Before and after 750 hours of UV exposure per ASTM D4329 cycle A).
6. The bearing bars shall be joined into panels by passing continuous length fiberglass pultruded cross rods through the web of each bearing bar. A continuous fiberglass pultruded bar shaped section shall be wedged between the two cross rod spacers mechanically locking the notches in the cross rod spacers to the web of the bearing bars. Continuous adhesive bonding shall be achieved between the cross rod spacers and the bearing web and between the bar shaped wedge and the two cross rod spacers locking the entire panel together to give a panel that resists twist and prevents internal movement of the bearing bars. Each stair tread shall utilize a box-shaped nosing on its lead edge to enclose cross rods and ensure a smooth vertical edge.
7. All bearing bars that are to be exposed to UV shall be coated with polyurethane coating to provide additional UV protection.
8. If required, all cut and machined edges, holes and abrasions shall be sealed with a resin or compatible coating with the resin matrix used in the bearing bars and cross rods.
9. The materials covered by these specifications shall be furnished by an ISO-9001:2008 certified manufacturer.

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use. Use 2 hold-down clamps at each support with a minimum of 4 per panel. Select fasteners for type, grade, and class required.
- B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 2.
- C. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
 1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 (A4) stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.5 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 hairline 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.

2.6 GRATING FRAMES AND SUPPORTS

- A. Frames and Supports for Glass-Fiber-Reinforced-Plastic Gratings: 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 or built into masonry with integral anchors.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. 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 or masonry.
- D. Fit exposed connections accurately together to form hairline joints.

3.2 INSTALLING GLASS-FIBER-REINFORCED-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.

END OF SECTION 067413

SECTION 071113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Hot-applied asphalt dampproofing.
 - 2. Cold-applied, cut-back-asphalt dampproofing.
 - 3. Cold-applied, emulsified-asphalt dampproofing.

1.3 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product.

1.4 INFORMATION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.5 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide protection course molded-sheet drainage panels and auxiliary materials recommended in writing by manufacturer of primary materials.
- B. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise required.

2.2 HOT-APPLIED ASPHALT DAMPPROOFING

- 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. Owens Corning Roofing and Asphalt, LLC; Trumbull Division.
- B. Hot-Applied Asphalt: ASTM D 449, Type II.

2.3 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

- 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. APOC, Inc.; a division of Gardner-Gibson.
 - 2. BASF Construction Chemicals - Building Systems; Sonneborn Brand Products.
 - 3. Brewer Company (The).
 - 4. ChemMasters, Inc.
 - 5. Euclid Chemical Company (The); an RPM company.
 - 6. Henry Company.
 - 7. Karnak Corporation.
 - 8. Koppers Inc.
 - 9. Malarkey Roofing Products.
 - 10. Meadows, W. R., Inc.

- B. Trowel Coats: ASTM D 4586, Type I, Class 1, fibered.

- C. Brush and Spray Coats: ASTM D 4479, Type I, fibered or nonfibered.

2.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 1. APOC, Inc.; a division of Gardner-Gibson.
 2. BASF Construction Chemicals - Building Systems; Sonneborn Brand Products.
 3. Brewer Company (The).
 4. ChemMasters, Inc.
 5. Euclid Chemical Company (The); an RPM company.
 6. Gardner-Gibson, Inc.
 7. Henry Company.
 8. Karnak Corporation.
 9. Koppers Inc.
 10. Malarkey Roofing Products.
 11. 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.

2.5 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Cut-Back-Asphalt Primer: ASTM D 41.
- C. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
 1. Primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- E. Patching Compound: Epoxy or latex-modified repair mortar of type recommended in writing by dampproofing manufacturer.
- F. Protection Course: Extruded-polystyrene board insulation, unfaced, ASTM C 578, Type X, 1/2 inch thick.

2.6 MOLDED-SHEET DRAINAGE PANELS

- A. Molded-Sheet Drainage Panel: Comply with Section 334600 "Subdrainage."
- B. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core; and with a vertical flow rate of 9 to 15 gpm per ft..
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. American Hydrotech, Inc.
 - b. Carlisle Coatings & Waterproofing Inc.
 - c. Grace, W. R., & Co. - Conn.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.
 - 1. Test for surface moisture according to ASTM D 4263.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. 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 the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.
- C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for substrate preparation, dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, 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.
 - 1. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 2. 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.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Footings and Foundation Walls: Apply two 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.

3.5 INSTALLATION OF PROTECTION COURSE

- A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.
 - 1. Install protection course on same day of installation of dampproofing (while coating is tacky) to ensure adhesion.

3.6 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate dampproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
 - 1. Install protection course before installing drainage panels.

3.7 CLEANING

- A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071113

SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section includes penetrating oil, water, and stain repellent treatments for the following exterior and interior vertical and horizontal above grade surfaces:
 - 1. Cast-in-place concrete.
- B. Related Sections:
 - 1. Section 033000 "Cast-in-Place Concrete" for slabs-on-grade.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's printed statement of VOC content.
 - 2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.
 - 3. Include printout of current "MPI Approved Products List" for each product category specified in Part 2 that specifies water repellents approved by MPI, with the proposed product highlighted.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

- C. Qualification Data: For Applicator.
- D. Product Certificates: For each type of water repellent.
- E. Preconstruction Test Reports: For water-repellent-treated substrates.
- F. Field quality-control reports.
- G. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Applicator Qualifications: An employer of workers trained and approved by manufacturer.
- C. MPI Standards: Comply with MPI standards indicated and provide water repellents listed in its "MPI Approved Products List."
- D. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Locate mockups on existing surfaces where directed by Architect.
 - a. Size: 50 sq. ft. each.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Testing: Engage a qualified testing agency to perform preconstruction testing of water repellents on field mockups.
 - 1. In addition to verifying performance requirements, use mockups to verify manufacturer's written instructions for application procedure and optimum rates of product application to substrates.
 - 2. Notify Architect seven 7 days in advance of the dates and times when mockups will be tested.

1.7 FIELD 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. Concrete surfaces and mortar have cured for not less than 28 days.
 2. Building has been closed in for not less than 30 days before treating wall assemblies.
 3. Ambient temperature is above 40 deg F and below 90 deg F and will remain so for 24 hours.
 4. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 90 deg F.
 5. Rain, snow, or mist is not predicted within 24 hours.
 6. Not less than 24 hours have passed since surfaces were last wet.
 7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.
- B. Ventilation: Provide adequate ventilation and airflow during and after application.
Building air intakes should be protected from allowing vapors to enter the building.
- C. Protection:
1. Wear protective goggles, gloves, and clothing during the application of the material.
 2. Warn personnel against breathing vapors and contact of materials with skin or eyes.
 3. In confined areas workmen shall wear approved chemical-cartridge type masks.
 4. Keep products away from heat, sparks and flames. Do not allow the use of spark producing equipment during application and until vapors are gone.
 5. Post "No Smoking" signs.

1.8 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace structurally sound treated surfaces that fail to retain water and salt repellent properties specified in "Performance Requirements" Article within specified warranty period.
1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Performance: Water repellents shall meet the following performance requirements as determined by preconstruction testing on manufacturer's standard substrates representing those indicated for this Project.
- B. Water Absorption: Minimum 90 percent reduction of water absorption after 24 hours for treated compared to untreated specimens when tested according to the following:
 - 1. Cast-in-Place Concrete: ASTM C642.
- C. Water-repellent sealer shall have the following minimum performance properties:
 - 1. Reduction in Chloride Ion absorption: 90%, NCHRP 244 Series II.
 - 2. Reduction in Chloride Ion absorption: 80%, NCHRP 244 Series IV.
 - 3. Scaling resistance rating: 100 freeze thaw cycles; 0 (no scaling), ASTM C-672.
 - 4. Depth of Penetration: 0.150 - 0.26" depending on substrate, ASTM D-457.
 - 5. Water Vapor Permeability: 95%, ASTM E-96.
 - 6. Water Absorption Reduction in Hardened Concrete: > 98%, ASTM C-642.
 - 7. VOC content: <250 grams/liter.
 - 8. Durability: Maximum 5 percent loss of water-repellent performance after 2500 hours of weathering according to ASTM G154 compared to water-repellent-treated specimens before weathering.
 - 9. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate of treated compared to untreated specimens, according to ASTM E514/E514M.

2.2 PENETRATING WATER REPELLENTS

- A. Basis-of-Design Product: Clear, low VOC oil, water, and stain repellent, Certi-Vex Penseal 244 O/W AIM by Vexcon Chemicals, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
 - 1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three (3) representative locations by method recommended by manufacturer.
 - 2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.

3. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.
- B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:
 1. Cast-in-Place Concrete: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents according to ASTM E 1857.
- C. Protect adjoining work, including mortar and 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 vegetation.
- D. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- E. Coordination with Sealant Joints: 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 required.

3.3 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. Apply coating of water repellent on surfaces according to manufacturer's written instructions for application procedure unless otherwise indicated.
- C. Apply a second saturation 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.
- D. Close air-intake louvers, windows and other openings.
- E. Do not dilute material. Material should be agitated before and during application.

3.4 FIELD QUALITY CONTROL

- A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:
 - 1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Contractor to conduct testing in the presence of the Engineer and certify results.
 - 3. Testing agency will perform tests for compliance of water-repellent material with product requirements.
 - 4. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor shall remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect.

- B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.
 - 1. Notify Architect seven (7) days in advance of the dates and times when surfaces will be tested.
 - 2. Reapply water repellent until coverage test indicates complete coverage.

3.5 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Extruded polystyrene foam-plastic board.
 - 2. Polyisocyanurate foam-plastic board.
 - 3. Glass-fiber blanket insulation
 - 4. Vapor retarders.
 - 5. Insulation fasteners
- B. Related Sections:
 - 1. Section 042200 "Concrete Unit Masonry" for polyisocyanurate foam-plastic board insulation installed in masonry cavity wall and molded expandable polystyrene inserts at unit masonry open cores.
 - 2. Section 054000 "Cold-Formed Metal Framing" for glass-fiber blanket insulation at roof framing.

1.3 RELATED SECTIONS

1.4 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 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. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product test reports.
- C. Research/evaluation reports.
- D. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION FOR UNDER-SLAB INSULATION

- A. Extruded-Polystyrene Board Insulation at cavity walls: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 - 2. Type V, 100 psi for UNDERSLAB INSULATION
 - 3. Thickness: 2”, R 5.0-5.6 per inch of thickness
- B. Unfaced Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type IV, 25-psi or Type VI, 40-psi minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Pactiv Building Products.

2.2 MOLDED EXPANDABLE POLYSTYRENE FOR CONCRETE MASONRY UNIT CORE INSERTS

- A. Molded Expandable Polystyrene Inserts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. KORFIL, Concrete Block Insulating Systems, Inc.
- b. Approved equal.

2.3 POLYISOCYANURATE FOAM-PLASTIC BOARD

- A. Polyisocyanurate Board, Glass-Fiber-Mat Faced: ASTM C1289, glass-fiber-mat faced, Type II, Class 2.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 3. Thickness: 1 1/2", R-9.

2.4 GLASS-FIBER BLANKET INSULATION

- 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. CertainTeed Corporation.
 2. Guardian Building Products, Inc.
 3. Johns Manville.
 4. Dow Chemical Company (The)
 5. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 1. Thickness: 12", R-38
- C. Glass-fiber Blanket, Polypropylene-Scrim-Kraft Faced at roof joists: ASTM C665, Type II (nonreflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).

2.5 VAPOR RETARDERS

- 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. CertainTeed Corporation.
 2. Guardian Building Products, Inc.
 3. Johns Manville.
 4. Owens Corning.

5. Dow Chemical Company (The).
- B. Polyethylene Vapor Retarders: ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.13 perm.
 1. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder
 - C. Air/Vapor Barrier Membrane:
 1. Basis of Design Product: Subject to compliance with requirements, provide Dow Corning DefendAir 200, as well as DOWSIL silicone transition strip, and DOWSIL 758 silicone weather barrier sealant manufactured by Dow Chemical Company (The) or approved equal.
 - a. Membrane shall be 100% silicone liquid applied air and weather barrier membrane with an assembly air leakage rate of less than 0.000007 cfm/ft² at 1.57 psf when tested to ASTM E2357, nominal total dry coating thickness of 15 mils.
 - b. Silicone transition strip shall have tensile strength of 800 psi when tested to ASTM D412.
 - c. Silicone weather barrier sealant shall be for porous substrates with tensile strength of 200 psi when tested to ASTM D412.

2.6 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
 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. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
 - b. 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. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
 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. Gemco; 90-Degree Insulation Hangers.
 2. Angle: Formed from 0.030-inch- thick, perforated, galvanized carbon-steel sheet with each leg 2 inches square.
 3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.

- C. 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGM Industries, Inc.; RC150 or SC150.
 - b. Gemco; Dome-Cap R-150 or S-150.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications 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 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. 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.

3.2 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 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.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- 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. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.4 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

- A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
 2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.5 INSTALLATION OF VAPOR RETARDERS

- A. Polyethylene Vapor Retarders:
1. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
 2. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.
 3. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c.
 4. Before installing vapor retarders, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings.

Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.

5. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.
6. 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 retarders.
7. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

B. Air/Vapor Barrier Membrane:

1. Air/Vapor Barrier Membrane can be applied by spraying, power roller, roller and/or brush.
2. A wet applied 30-32 wet mil thickness will yield a 17 mil dry film thickness.
3. Spray or roller apply the coating in an appropriate manner to ensure a uniform and seamless application.
4. Touch up or damage repair can be accomplished using spray, power roller, roller or brush and can proceed at anytime after application; while coating is still wet or while coating is dry (cured).
5. Application is not recommended when the temperature is below 20° F (-6° C) or if frost or moisture is present on the surfaces to be coated.
6. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with silicone transition strip or sealant to create an airtight seal between penetrating objects and air/vapor barrier membrane.
7. Allow air barrier to fully dry prior to adhering to other materials to the surface of the air barrier.

3.6 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) 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.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Concrete Unit Masonry."

END OF SECTION 072100

SECTION 073200 – COMPOSITE ROOF TILE SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Polymeric slate roof tile system.
 - 2. Underlayment.
 - 3. Metal flashing and trim.
- B. Related Sections:
 - 1. Section 077100 "Roof Specialties" for roof edge drainage systems (gutters).
 - 2. Section 061600 “Sheathing” for plywood roof sheathing protection board.
 - 3. Section 074113.13 “Formed Metal Roof Panels”.
 - 4. Section 074293 “Soffit Panels”.

1.3 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product.
- C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.5 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Manufacturer's Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.
 - 1. Material Warranty Period: 50 years from date of Substantial Completion, prorated, with first seven years non-prorated.
 - 2. Wind-Speed Warranty Period: Polymeric shingles will resist blow-off or damage caused by wind speeds of up to 130 mph for 15 years from date of Substantial Completion.
 - 3. Algae-Resistance Warranty Period: Polymeric shingles will not discolor for 15 years from date of Substantial Completion.
 - 4. Workmanship Warranty Period: 25 years from date of Substantial Completion.

1.7 CLOSEOUT SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS

1.8 EXTRA STOCK

- A. Submit the following in accordance with form 817 Article 1.20-1.08.14, NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS for additional information.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Polymer Slate Roof Tiles: 100 sq. ft. in unbroken bundles.

PART 2 - PRODUCTS

2.1 POLYMERIC SLATE ROOF TILE SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide EcoStar LLC; Majestic Slate Designer Series, scallop appearance.

1. Strip Size: Manufacturer's standard.
2. Water Absorption: ASTM D 570, 0 percent by weight
3. UV Exposure: Tested in accordance with ASTM G 155, prolonged exposure
4. Tapered Thickness: Nominal ¼ inch
5. Tile Length: 18 inches
6. Wind Resistance: UL 997, Class F (110-mph)
7. Fire Resistance: UL Class A
8. Impact Resistance: UL 2218, Class 4.
9. Color and Blends: As selected by Architect from manufacturer's standards.
10. Design: Beveled Edge
11. Tile Width: 12 inches
12. Exposure: 6 inches

B. Acceptable Manufacturers: Subject to compliance with requirements, manufactures offering products that may be incorporated in the Work include, but are not limited to, the following:

1. EcoStar LLC
 - a. Polymeric Slate tiles: "Majestic Designer Series" or approved equal.

2.2 UNDERLAYMENT MATERIALS

A. Sheet Underlayment in compliance to CCRR 0217 for Class A Fire Rating, GAF Versa Shield or approved equal.

2.3 ACCESSORIES

- A. Tile Fasteners: Stainless steel
1. Head: 3/8 inch (9.5 mm) diameter head.
 2. Nails: In coils, ring shank, for use in pneumatic tools - available in 1-1/2 inch (38 mm) and 1-3/4 inch (44 mm).
 3. Nails: In coils, ring shank, for use in pneumatic tools - available in 1-1/2 inch (38 mm) and 1-3/4 inch (44 mm).
- B. Underlayment Fasteners: As recommended in writing by synthetic-underlayment manufacturer for application indicated.

2.4 METAL FLASHING AND TRIM

- A. General: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
1. Sheet Metal: Aluminum, mill finished.
- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

- A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

3.2 GAF VersaShield® underlayment must be installed over the entire deck surface including over the Glacier Guard in conjunction with EcoStar Class A Majestic Tiles for those projects requiring a UL Class A fire rating. GAF VersaShield should be installed per manufacturer's specification. Metal flashing installation.

3.3 COMPOSITE SLATE TILE INSTALLATION

- A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Install starter strip along lowest roof edge, consisting of slate tiles gapped a minimum of 3/8" between tiles and any protrusions while achieving a 3/4" overhang. The final tile at roof edge must be a minimum of 3" wide.
 - 1. Extend slate tiles 3/4 inch over fascia at eaves and rakes.
 - 2. Install starter strip along rake edge.
- C. Fasten slate tile strips with roofing nails located according to manufacturer's written instructions.

END OF SECTION 073113

SECTION 074113.13 - FORMED METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Horizontal-seam (Bermuda-type) metal roof panels – Located at utility building.
 - 2. Flashing and Trim – Located at utility building.
- B. Related Sections:
 - 1. Section 061600 "Sheathing" for plywood roof sheathing protection board.
 - 2. Section 073200 "Composite Roof Tile Systems".
 - 3. Section 076200 "Sheet Metal Flashing and Trim" for Formed Metal Roof underlayment.
 - 4. Section 077253 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.
 - 5. Section 077100 "Roof Specialties".

1.3 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 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 type of panel and accessory.
- C. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- D. Samples for Initial Selection: For metal panel indicated with factory-applied color finishes.
1. Include similar Samples of trim and accessories involving color selection.
- E. Samples for Verification: For exposed finish required, prepared on Samples of size indicated below:
1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
- C. Qualification Data: For Installer.
- D. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- E. Field quality-control reports.
- F. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS

1.6 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- C. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- C. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- D. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, 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.
- E. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the 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 panel systems 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: Two years from date of Substantial Completion.

- C. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel 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 date of Substantial Completion.
- D. Special Weathertightness Warranty: Manufacturer's standard form in which 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 date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. FM Approvals' Listing: Manufacture and install roof-edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-120. Identify materials with FM Approvals' markings.
- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
 - 1. Wind Loads: As indicated on Structural Drawings.
 - 2. Other Design Loads: As indicated on Structural Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680[or ASTM E283] at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class required by wind loads indicated on the structural drawings.
 - 1. Uplift Rating: UL 90.
- F. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM

Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-100.
2. Hail Resistance: MH.

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 HORIZONTAL-SEAM (BERMUDA-TYPE) METAL ROOF PANELS

A. Horizontal-Seam (Bermuda-Type) Metal Roof Panels: Formed with horizontal seam at panel edges and smooth, flat pan; designed to be installed in sequential installation by engaging lower edge of each panel to upper edge of panel below and mechanically attaching panels to supports using concealed clips located under upper edge of panels.

1. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: 0.040 inch.
 - b. Surface: Smooth, flat finish.
 - c. Exterior Finish: Three-coat fluoropolymer.
 - d. Color: As selected by Architect from manufacturer's full range.
2. Clips: One piece.
 - a. Material: 0.025-inch- thick, stainless-steel sheet.
3. Seal: Factory-applied sealant or vinyl weatherseal in seam.
4. Exposure: 11 inches nominal.
5. Seam Height: 1.0 inch.

2.3 UNDERLAYMENT MATERIALS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Grace Ice & Water Shield, by GCP Applied Technologies, or approved equal.

B. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 220 deg F; ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 29 deg C; ASTM D1970.

2.4 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating 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. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal 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 panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels 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. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.
- E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
- F. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed
- G. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 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 C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to 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 sealant and 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 in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 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 same piece are unacceptable. 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.

C. Aluminum Panels and Accessories:

1. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
1. Apply over the entire roof surface.

- B. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.4 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air or water-resistive barriers and flashings that are concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

- B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

Horizontal-Seam (Bermuda-Type) Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each horizontal-seam joint at location, spacing, and with fasteners recommended by manufacturer. Start at eave and work upward toward ridge.

1. Install clips to supports with self-drilling fasteners.

- D. Accessory Installation: 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 panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended in writing by metal panel manufacturer.

- E. Flashing and Trim: 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. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without 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 achieve waterproof 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 expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- F. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- G. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
1. Provide elbows at base of downspouts to direct water away from building.
 2. Connect downspouts to underground drainage system indicated.

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 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. Remove and replace applications where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113.13

SECTION 074293 - SOFFIT PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section includes metal soffit panels (perforated).
- B. Related Sections:
 - 1. Section 073200 "Composite Roof Tile Systems" at utility building".
 - 2. Section 061063 "Exterior Rough Carpentry".

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Contractor must attend preinstallation conference which shall be scheduled by the Construction Manager.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS
- B. Maintenance Data: For metal soffit panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- C. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to 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, 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.
- D. Retain strippable protective covering on metal panels during installation.
- E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the 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 panel systems 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 maximum available warranty from date of Substantial Completion.
- C. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: Manufacturer's maximum available warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B. 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 METAL SOFFIT PANELS

- A. Metal Soffit Panel Profile: Perforated panels to match profile and material of metal roof panels.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Hunter Douglas; Ceiling Linear Panel - 84R or comparable product by one of the following:
 - a. Hunter Douglas.
 - b. Or approved equal.
 - 2. Material: Same material as indicated per Basis of Design Product. Finish as selected by Architect from manufacturer's standard finishes. Perforated panels at utility building exterior soffit. Color as selected by Architect from manufacturer's standard colors.

2.3 MISCELLANEOUS MATERIALS

- A. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- B. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to 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 sealant and 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 in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 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 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.
- C. Aluminum Panels and Accessories:
 - 1. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Exposed Anodized Finish:
 - a. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
 - b. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
 - a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.
 - 1. Soffit Framing: Clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
- B. Fasteners:
 - 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior.

2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Apply panels and associated items true to line for neat and weathertight enclosure.
 2. 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.
 3. 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.
- E. Accessory Installation: 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 panel system including trim, corners, seam covers, flashings, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- F. Flashing and Trim: 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 are permanently watertight.
1. Install exposed flashing and trim that is without 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 achieve waterproof 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 expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074293

SECTION 074650 – EXTERIOR SIDING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Poly-Ash siding applied on exterior surfaces of the utility building as indicated on the contract drawings.
 - 2. Cellular PVC trim applied to exterior surfaces of the utility building as indicated on the contract drawings.
- B. Related Sections:
 - 1. Section 061063 "Exterior Rough Carpentry" for wood furring, grounds, nailers, and blocking.
 - 2. Section 099113 “Exterior Painting”.

1.3 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.06.25 – “Facilities Construction – Product Selection”.
- B. Product Data: For each type of product indicated.
- C. Samples for Verification: Samples: Submit three material samples representative of the texture, thickness and widths shown and specified herein.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.06.25 – “Facilities Construction – Product Selection”.
- B. Product Certificates: For each type of siding, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.
- D. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS
- B. Maintenance Data: For each type of siding and related accessories to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Allowable Tolerances:
 - 1. Variation in component length: -0.00 / +1.00”
 - 2. Variation in component width: $\pm 1/16$ ”
 - 3. Variation in component thickness: $\pm 1/16$ ”
 - 4. Variation in component edge cut: $\pm 2^\circ$
 - 5. Variation in Density -0% + 10%
- C. Workmanship, Finish, and Appearance:
 - 1. Free foam cellular pvc that is homogeneous and free of voids, holes, cracks, and foreign inclusions and other defects. Edges must be square, and top and bottom surfaces shall be flat with no convex or concave deviation.
 - 2. Uniform surface free from cupping, warping, and twisting.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 817 Articles 1.20-1.06.03 – “Facilities Construction – Storage” and 1.20-1.06.05 – “Facilities Construction – Shipping Material”.
- B. Trim materials should be stored on a flat and level surface on a full shipping pallet. Handle materials to prevent damage to product edges and corners. Store materials under a protective covering to prevent jobsite dirt and residue from collecting on the boards.

1.8 COORDINATION

- A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

1.9 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Special Warranty: Standard form in which manufacturer agrees to repair or replace trim that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracking, deforming, and fading.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 POLY-ASH SIDING

- A. Manufacturer: “Boral TruExterior” siding by Boral Composites Inc., 200 Mansell Court East, Suite 305, Roswell, Georgia 30076. Toll Free 888-926-7259. Website www.boraltruexterior.com, E-mail info@truexterior.com, or approved equal.
- B. Poly-ash Siding:
 - 1. Material: Polymeric blend, fly ash, and glass fibers.
 - 2. Formed in continuous process and milled to give a surface profile.
 - 3. Profile: Channel
 - 4. Nominal Width: 6 inches.
 - 5. Nominal Thickness: 3/4 inch.
 - 6. Length: 16 feet
 - 7. Exposed Texture: Smooth.

2.2 CELLULAR PVC TRIM

- A. General: Freefoam Cellular PVC that is homogenous and free of voids, holes, cracks, and foreign inclusions and other defects. Edges must be square and top and bottom surfaces shall be flat with no convex or concave deviation. Material shall be produced from PVC resins, recycled PVC and have an integral white color.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AZEK® Trimboards manufactured by Vycom

- b. CertainTeed Restoration Millwork Cellular PVC Trim.
- c. Kleer Lumber Inc., 866-KLEER70, www.kleerlumber.com

- B. Trim Panels:
 - 1. Size: 1 x 3.
 - 2. Length: 16 feet.
 - 3. Exposure Texture: Smooth.

2.3 ACCESSORIES

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
 - 1. Provide accessories made from same material as adjacent siding unless otherwise indicated.
- B. Fasteners: For fastening to wood and other substrates, use 8d by 2 ½" long stainless steel ring shank nails or epoxy-coated trim screws to penetrate a minimum of 1 inch into substrate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

- A. General: Comply with siding manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 - 1. Do not install damaged components.
- B. Install in accordance with manufacturer's instructions. Comply with manufacturer guidelines and recommended techniques.
 - 1. Comply with all terms necessary to maintain warranty coverage.
 - 2. Use trim details indicated on drawings.
 - 3. Install horizontal stud blocking, to match material and depth of stud wall, per manufacturer's recommended spacing.
- C. Cutting:

1. Use conventional woodworking saws.
 2. Use carbide tipped blades designed to cut wood. Do not use fine-tooth metal-cutting blades.
 3. Avoid rough edges from cutting caused by: excessive friction, poor board support, worn saw blades or badly aligned tools.
- D. Drilling:
1. Do not use bits made for rigid PVC.
 2. Avoid frictional build-up and remove shavings from the drill hole frequently as necessary.
 3. Drill with standard woodworking drill bits.
- E. Milling:
1. Mill using standard milling machines used to mill lumber.
 2. Relief angle 20 to 30 degrees.
 3. Do not score material.
 4. Cutting speed to be optimized with the number of knives and feed rate.
- F. Routing:
1. Rout using standard bits and the same tools used to rout lumber.
 2. Carbide tipped router bits recommended.
- G. Edge Finishing:
1. Edges can be finished by sanding, grinding, or filling with traditional woodworking tools.
- H. Joints:
1. Provide bevel or shiplapped joints for material subject to expansion and contraction. Do not use butt joints.
 2. Provide butt joints for corner units or T-joints, only.
- I. Heat Forming:
1. Utilize convection air circulating oven, strip heater, or radiant heaters to heat material from both sides.
 2. Do not overheat material. Surface temperature shall not exceed 320 degrees F (160 degree C) for more than 10 minutes.
 3. Secure pliable material around a template to obtain finished shape during cooling.
 4. Cool with natural air circulation, fans or compressed air.
- J. Thermal Expansion and Contraction:
1. Expansion and contraction of trim material will occur with changes in temperature. Using the appropriate quantity of the proper fasteners along the entire length of Klear is essential to help minimize expansion and contraction.
 2. Follow manufacturer's guidelines for required gap width between trim pieces.
- K. Fastening:
1. Fasteners shall be hand nailed, power nailed, or screwed.
 2. Power Nailing: Adjust nail gun to prevent excessive nailing pressure or overdriving the nail. Adjust for ambient and material temperatures.
 3. Pre-drill material when installing in low temperatures.
 4. Fasteners should be long enough to penetrate into a 1-1/2 inch solid wood substrate a minimum of 1-1/2 inch.

5. Staples, small brads and wire nails must not be used as fastening members.
 6. Fasten trim into a flat, solid wood substrate that is a minimum 1-1/2 inches (38 mm) thick. Do not fasten trim into hollow or uneven substrates.
- L. Fastener Schedule:
1. Along Length of Board: Fasten at 16 inches (406.4 mm) on center, maximum.
 2. Within Width of Board: 4 inches (101.6 mm) on center, maximum.
 3. Distance from End of Each Board: Not more than 2 inches (50.8 mm).
- M. Bonding:
1. Follow adhesive manufacturer's guidelines.
 2. Glue joints shall be secured on each side of the joint to allow adequate bonding time.
 3. Surfaces to be glued should be clean and dry and in complete contact with each other. Smooth surfaces shall be sanded and cleaned prior to bonding.
 4. Use PVC adhesive when installing short runs of trim.
- N. Finishing:
1. Correct dents and gouges before applying final coating.
 2. Nail holes should be filled using manufacturer's structural sealant or cellular PVC adhesive.
 3. Paint as specified in Section 099113 "Exterior Painting".
 4. Clean material with a light detergent and warm water. Stubborn stains may be removed rubbing alcohol.
- O. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074650

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Manufactured reglets with counterflashing.
 - 2. Formed wall sheet metal fabrications.
- A. Related Sections:
 - 1. Section 061063 "Exterior Rough Carpentry" for wood nailers, curbs, and blocking.
 - 2. Section 077100 "Roof Specialties" for roof-edge flashings, and counterflashings.
 - 3. Section 074113.13 "Formed Metal Roof Panels".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Distinguish between shop- and field-assembled work.
 - 3. Include identification of finish for each item.
 - 4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.
- C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.
- C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS
- B. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. 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 SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

1.7 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

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" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
 - 1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Color: Custom color to be selected by Architect.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 40 mils thick, consisting of a slip-resistant polyethylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
 - 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
 - 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.
 - 3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Grace Ice and Water Shield HT.
 - c. Owens Corning; WeatherLock Metal High Temperature Underlayment.
 - 4. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.

- 5. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.
- B. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D 4397.
- C. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

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 as 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.
 - b. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, 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 polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED REGLETS

- A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.

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. Cheney Flashing Company.
 - b. Fry Reglet Corporation.
 - c. Heckmann Building Products, Inc.
2. Material: Aluminum, 0.024 inch thick.
3. Finish: With manufacturer's standard color coating.

2.6 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 1. Obtain field measurements for accurate fit before shop fabrication.
 2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. 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.
 2. Use lapped expansion joints only where indicated on Drawings.
- C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- G. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

2.7 WALL SHEET METAL FABRICATIONS

- A. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch thick.
- B. Wall Expansion-Joint Cover: Fabricate from the following materials:
 - 1. Aluminum: 0.040 inch thick.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive 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.
- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
- C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

3.2 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, 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, 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. Attach each cleat with at least 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.

- 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-aluminum 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 substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.3 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. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.4 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.

END OF SECTION 076200

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof-edge flashings.
 - 2. Roof-edge drainage systems.
 - 3. Counterflashings.
- B. Related Sections:
 - 1. Section 061063 "Exterior Rough Carpentry" for wood nailers, curbs, and blocking.
 - 2. Section 074113.13 "Formed Metal Roof Panels" for roof-edge drainage-system components provided by metal-roof-panel manufacturer.
 - 3. Section 076200 "Sheet Metal Flashing and Trim" for custom and site-fabricated sheet metal flashing and trim.
 - 4. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.
 - 5. Section 073200 "Composite Roof Tiles".

1.3 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 copings and roof-edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-120. Identify materials with FM Approvals' markings.
- C. SPRI Wind Design Standard: Manufacture and install copings and roof-edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

D. 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.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 817 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 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.
3. Details of termination points and assemblies, including fixed points.
4. Details of special conditions.

D. Samples for Verification: For roof-edge flashings, roof-edge drainage systems, and counterflashings made from 12-inch lengths of full-size components including fasteners, cover joints, accessories, and attachments.

1.5 INFORMATIONAL SUBMITTALS

A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for roof-edge flashings.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Submit the following in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS

- B. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. 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.
- C. 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.

1.9 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof specialties 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 D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EXPOSED METALS

- A. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
 - 1. Surface: Smooth, flat finish.
 - a. 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.

- b. Concealed Surface: Pretreat with 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. Aluminum Extrusions: ASTM B 221, 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. (All Areas, Unless Specified Below) Two-Coat Fluoropolymer: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
 - 2. (Areas around Waiting Area Flat Roof) Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- C. Copper Clad Stainless Steel Sheet: ASTM B506-09, 10 percent thickness of copper metallurgically bonded on each side to an 80 percent core of Type 430 stainless steel, fully annealed. No adhesives or brazing alloys shall be required to achieve a permanent bond.
 - 1. Cross Section: Copper, stainless steel, copper.
 - 2. Standard Thicknesses: As recommended by manufacturer from the following standard thicknesses and weights:
 - a. 0.012 inches thick, 0.4959 pounds per square foot.
 - b. 0.016 inches thick, 0.6612 pounds per square foot.
 - c. 0.0216 inches thick, 0.8927 pounds per square foot.
 - d. 0.027 inches thick, 1.1159 pounds per square foot.
 - 3. Mechanically Fastened Joints: Copper, stainless steel, brass or bronze fasteners.
 - 4. Soldered Joints: Soft soldered using 50-50 or higher tin content solder, mild fluxes.
 - 5. Shapes: Coils, rolls or sheets up to 24 inches wide, as applicable.
- D. Accessories: Provide all clips, cleats, straps, anchors, similar items necessary to properly complete the work. Provide accessories that are compatible with sheet metal materials used and which are of sufficient size and gage to perform as intended.

2.2 CONCEALED METALS

- A. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.
- B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

- B. Self-Adhering, High-Temperature Sheet: Minimum 40 mils thick, consisting of a slip-resistant polyethylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.
 3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Grace Ice and Water Shield HT.
 - c. Owens Corning; WeatherLock Metal High Temperature Underlayment.
 4. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
 5. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.
- C. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D 4397.
- D. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

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.
 2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
- C. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- 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.
- E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.
- G. Solder for Copper: ASTM B 32, lead-free solder.

2.5 ROOF-EDGE FLASHINGS

- A. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on or compression-clamped metal fascia cover in section lengths not exceeding 12 feet and a continuous formed galvanized-steel sheet cant, 0.028 inch thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.
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. Castle Metal Products.
 - b. Hickman Company, W. P.
 - c. Petersen Aluminum Corporation.
 2. Fascia Cover: Fabricated from the following exposed metal:
 - a. Extruded Aluminum: Thickness as required to meet performance requirements.
 3. Corners: Factory mitered and soldered or continuously welded.
 4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
 5. Special Fabrications: Sections as indicated on the Drawings
 6. Fascia Accessories: Fascia extenders with continuous hold-down cleats.
- B. Roof-Edge Apron with integral drip edge (Historic Facility): Custom fabricated, "F" style one-piece, roof-edge apron in section lengths not exceeding 12 feet and an integral 3/4 inch drip-edge.
1. Corners: Mitered and soldered.
 2. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.

2.6 ROOF-EDGE DRAINAGE 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. Castle Metal Products.
 2. Hickman Company, W. P.
 3. Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.
- B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
1. Fabricate from the following exposed metal:
 - a. Formed Aluminum: 0.050 inch thick.
 2. Gutter Profile: As indicated on Drawings and according to SMACNA's "Architectural Sheet Metal Manual."
 3. Applied Fascia Cover (Concealed Gutter): Exposed, formed aluminum, 0.040 inch thick, with factory-mitered corners, ends, and concealed splice joints. Corners: Factory mitered and soldered or continuously welded.

4. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
 5. Special Fabrications: Shape as indicated on drawings.
 6. Gutter Accessories: Continuous screened leaf guard with sheet metal frame or Continuous hinged leaf guard of solid metal designed to shed leaves, and Wire ball downspout strainer.
 7. Color: Custom color to be selected by Architect (match adjacent Standing Seam roof).
- C. Downspouts: Plain round complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
1. Extruded Aluminum: 0.125 inch thick.

2.7 COUNTERFLASHINGS

- 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. Castle Metal Products.
 2. Fry Reglet Corporation.
 3. Hickman Company, W. P.
- B. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
1. Formed Aluminum: 0.032 inch thick.
 2. Formed Aluminum: 0.032 inch thick.
- C. Accessories:
1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
 2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
- D. Aluminum Finish: Three-coat fluoropolymer.
1. Color: As selected by Architect from manufacturer's full range.

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. 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.
- B. Self-Adhering Sheet Underlayment: Install wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water. Overlap edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
- C. Polyethylene Sheet: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches.
- D. Slip Sheet: Install with tape or 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 and stainless-steel 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 Drawings.
 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 substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal joints with elastomeric or butyl 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.
1. washers at manufacturer's required spacing that meets performance requirements.

3.4 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.

3.5 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

- A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 12 inches apart. Attach ends with rivets and solder to make watertight. Slope to downspouts.
 - 1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion joint caps.
 - 2. Install continuous leaf guards on gutters with noncorrosive fasteners, removable or hinged to swing open for cleaning gutters.
- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.
 - 1. Provide elbows at base of downspout to direct water away from building.
 - 2. Connect downspouts to underground drainage system indicated.
- D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in elastomeric sealant.

3.6 COUNTERFLASHING INSTALLATION

- A. General: Coordinate installation of counterflashings with installation of base flashings.
- B. 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 or butyl sealant. Fit counterflashings tightly to base flashings.

3.7 CLEANING AND PROTECTION

- A. Clean and neutralize flux materials. Clean off excess solder and sealants.
- B. 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.
- C. 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 077253 - SNOW GUARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Snow guards for metal roofs.
 - 2. Non-penetrating attachment system.
- B. Related Sections:
 - 1. Section 074113.13 "Formed Metal Roof Panels" for horizontal-seam metal roof panels.

1.3 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.06.25 – "Facilities Construction – Product Selection".
- B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for snow guards.
- C. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.
 - 1. Include details of bracket and tubing type snow guards.
 - 2. Include calculation of number and location of snow guards based on snow load, roof slope, roof type, components, spacings, and finish, tailored to match actual project conditions.
- D. Samples: Brackets, tubing, couplings, end caps, end collars, ice flags and fasteners.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.06.25 – “Facilities Construction – Product Selection”.
- B. Product Test Reports: For each type of snow guard, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01 – “Facilities Construction – Source of Supply and Quality”.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Articles 1.20-1.06.03 – “Facilities Construction – Storage” and 1.20-1.06.05 – “Facilities Construction – Shipping Material”.
- B. Deliver four (4) spare snow and ice clips to Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Structural Performance:
 - 1. Snow Loads: As indicated on Structural Drawings.

2.2 RAIL-TYPE SNOW GUARDS

- A. Bracket and Tube Type Snow Guards:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide PP145 snow system including; guard bracket, tubing (snow fence), couplings, end caps, end collars, ice flags and fasteners, by Alpine Snow Guards (a division of Vermont Slate & Copper Services, Inc.), 289 Harrel St., Morrisvilles, VT www.alpinesnowguards.com (888) 766-4273 (Basis of Design) or approved equal.
 - 1. Description: Snow guard rails fabricated from tubing, anchored to brackets, fastened to metal roofing.
 - a. Snow Guard Brackets: Manufactured from 6000 Series Aluminum extrusions.
 - b. Tubing: Aluminum – 6000 Series

- 1) 1" outside diameter and .120" wall thickness, extruded.
- c. Couplings: Aluminum – 6000 Series
 - 1) Internal and concealed coupling 3" long.
 - 2) External and exposed coupling which can also serve as an expansion mechanism 5" long.
- d. End Caps: Type 316 Stainless Steel
- e. End Collars: 6000 Series Aluminum
- f. Ice Flags: 6000 Series Aluminum 3" wide x length (as needed).
- g. Fasteners: To be compatible with roof application and meet specified pull out values as shown in load test data.

C. Finish

- 1. Powder Coated – Custom color to be selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.
 - 1. Verify compatibility with and suitability of substrates including compatibility with existing finishes or primers.
 - 2. Prior to beginning installation, verify that:
 - a. Panel seaming is complete.
 - b. Panel attachment is sufficient to withstand loads applied by snow guard system.
 - c. Installation will not impede roof drainage.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean areas to receive attachments; remove loose and foreign matter that could interfere with installation or performance.

3.3 INSTALLATION

- A. Attachment for Standing-Seam Metal Roofing:
 - 1. Install snow guards according to manufacturer's written instructions. Space as indicated on drawings.
 - 2. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.
 - 3. Place clamps in straight, aligned rows.
 - 4. Place both set screws on same side of clamp.
 - 5. Tighten set screws to manufacturer's recommended torque. Randomly test set screw torque using calibrated torque wrench.
 - 6. Attach pipe members to brackets.
 - 7. Install splice connectors at cross member end joints.

8. Do not cantilever cross members more than 3 inches beyond last clamp at ends.

END OF SECTION 077253

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. High performance, closed cell, preformed joint seals and adhesive/bonding agent at platform joints in accordance with the details shown on the plans and the requirements of the specifications.
 - 2. Silicone joint sealants.
 - 3. Urethane joint sealants.
 - 4. Latex joint sealants.
- B. Related Sections:
 - 1. Section 033000 "Cast-in-Place Concrete".
 - 2. Section 042113 "Brick Masonry".
 - 3. Section 047200 "Cast Stone Masonry".
 - 4. Section 077100 "Roof Specialties".
 - 5. Section 089000 "Louvers and Vents"
 - 6. Section 092900 "Gypsum Board" for sealing perimeter joints.
 - 7. Section 066100 "Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels".

1.3 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each joint-sealant product indicated.

- C. 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.
- D. 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Qualification Data: For qualified Installer.
- C. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- D. Warranties: Sample of special warranties.
- E. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 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.
- C. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

1.6 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.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.8 WARRANTY

- A. Refer to Form 817 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- C. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- D. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

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. Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 PREFORMED JOINT MATERIALS

- A. Preformed Foam Joint: Manufacturer's standard preformed joint produced from low density closed cell cross linked Ethylene Vinyl Acetate Polyethylene Copolymer nitrogen blown material utilizing hindered amine light stabilizer for U.V. stability exhibiting the physical properties listed in the table below:

PHYSICAL PROPERTIES	TEST METHOD	REQUIREMENT
Elongation at break	ASTM D3575; Suffix: T	225% avg.
Tensile Strength, psi (kPa)	ASTM D3575; Suffix: T	115 psi +/- 20%
Tear Resistance	ASTM D624	10 – 20 lbs/inch
Density	ASTM D3575; Suffix W, Method A	2.7 – 3.4 lbs/ft ³
Water Absorption	ASTM D3575; Suffix L	0.035 lbs/ft ² avg.
Compression Deflection	ASTM D3575	25% 6 psi avg. 50% 16 psi avg.
Weather / Deterioration	ASTM G154	3000 hours No Effect
Compression Set 50% compression for 22 hours @ 73° F (23° C) 2 hr recovery 50% compression for 22 hours @ 73° F (23° C) 24 hour recovery	ASTM D3575; Suffix: B	10% set 9% set
Extrusion (specimen compressed 60% of original thickness with 3 restrained sides)	ASTM D545	Extrusion on free side does not exceed 0.25 inches (6.4mm)
Operating Temperature	In House	160° F (71° C) max.
Movement Range Compression Tension Shear (Horizontal & Vertical)	In House	50% 25% 50%±

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. Ceva 100 System by E-Poxy Industries (Chase Corporation)
 - b. Approved Equal

2.3 SEALANT/ADHESIVE

- A. JS-4 Joint Adhesive: 100% solids two component moisture insensitive modified epoxy adhesive which meets ASTM C-881 Type I & II Grades 1& 2 Class B & C and the requirements of the properties listed below:

Properties (uncured):

	Part A	Part B	Mixed
Color (Beige or Gray):	White/White	Carmel/Gray	Beige/Gray
Shelf Life	2 Years	2 Years	
Mixing ratio (By Vol)	3	1	3:1
Specific Gravity	1.47	1.15	
Density (lbs/gal) @ 77 ° F (25 ° C)	12.0 +/-0.5	9.7 +/-0.2	11.6 +/-0.2
Viscosity (cps) @ 77 ° F (25 ° C)	35,000	33,000	26,000
Pot Life (200 gms)			32-36 minutes
Initial Set @ 77 ° F			1 ½ - 2 Hours
Initial Cure			8-12 hours
Full Chemical Cure			7 days

Properties after Cure:

TEST	TEST METHOD	REQUIREMENT
Compressive Strength	ASTM D695	7000 psi
Tensile Strength	ASTM D638	3500 psi
Elongation at Break	ASTM D638	3-5%
Shore D hardness	ASTM D2250	85±5
Water Absorption	ASTM D570	0.25%
Bond Strength	ASTM C-882	430 psi min
Lap Shear		2000 psi min

2.4 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) 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.

2.5 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. Cast-in-Place Concrete.
 - b. Brick Masonry.
 - c. Cast Stone.
 - 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. 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. Installation of Preformed Foam Joints: Install each length of preformed joints 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.
- F. 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.
- G. 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.

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 Substantial Completion. 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.

3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces JS-1.
 - 1. Joint Locations:
 - a. Control and expansion joints in brick pavers.
 - b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Joints between different materials listed above.
 - 2. Urethane Joint Sealant: Immersible, single component, pourable, traffic grade.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces JS-#2.
 - 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints between different materials listed above.
 - d. Perimeter joints between materials listed above and frames of doors and windows.
 - e. Control and expansion joints in overhead surfaces.
 - 2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
 - 4. Joint Sealant: Latex.
 - 5. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
 - 6. Joint Sealant: Single component, nonsag, mildew resistant, acid curing.
 - 7. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section includes:
 - 1. Hollow-metal doors.
 - 2. Hollow-metal frames.
- B. Related Sections:
 - 1. Section 087100 "Door Hardware".
 - 2. Section 099113 "Exterior Painting" for finish painting of factory-primed doors.
 - 3. Section 089000 "Louvers and Vents".
 - 4. Section 099613 "Interior epoxy Painting".

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product.
- C. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- D. Samples for Initial Selection: For units with factory-applied color finishes.

- E. Samples for Verification: For each type of exposed finish required.
- F. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product test reports.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from multiple manufacturers.
- B. Smoke- and Draft-Control Door Assemblies: Provide assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
- C. Shipping Spreaders: Deliver welded frames with two removable spreader bars across bottom of frames, tack welded or mechanically attached to jambs and mullions.
- D. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.
 - 1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate installation of anchorages for stainless-steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Maximum-Duty Doors and Frames: SDI A250.8, Level 4. At locations indicated in the Door and Frame Schedule.
 - 1. Physical Performance: Level A according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A40 coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
 - f. Core: Polyisocyanurate.
 - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
 - 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A40 coating.
 - b. Construction: Full profile welded.
 - 4. Exposed Finish: Prime.

2.2 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 metal thickness. 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. Hollow-Metal Doors:
 - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.

2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 3. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
 4. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
 5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. 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. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
 - 1) Three anchors per jamb from 60 to 90 inches high.
 5. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
 6. Door Silencers: Except on weather-stripped frames, 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.
 7. Terminated Stops: Terminate stops 6 inches above finish floor with a 90-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
1. .

2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
3. Provide loose stops and moldings on inside of hollow-metal work.
4. Coordinate rabbet width between fixed and removable stops with installation types indicated.

2.3 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 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 and with installation spreaders in place, adjust and securely brace stainless-steel door frames for squareness, alignment, twist, and plumb 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.

3.2 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 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. 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.
 - b. Install frames with removable stops located on secure side of opening.
 - 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 plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
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 power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
5. 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 Steel Doors:
- a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

3.3 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 Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section includes:
 - 1. Furnishing and installation of all mechanical and electrical finish hardware necessary for all doors, and hardware as specified herein and as enumerated in hardware sets and as indicated and required by actual conditions at the building. The hardware shall include the furnishing of all necessary screws, bolts, expansion shields, drop plates, and all other devices necessary for the proper application of the hardware.
- B. Related Sections:
 - 1. Section 081113 "Hollow Metal Doors and Frames".

1.3 REFERENCES

- A. Applicable state and local building codes and standards.
- B. FIRE/LIFE SAFETY
 - 1. NFPA - National Fire Protection Association
 - a. NFPA 70 – National Electric Code
 - b. NFPA 80 - Standard for Fire Doors and Fire Windows
 - c. NFPA 101 - Life Safety Code
 - d. NFPA 105 - Smoke and Draft Control Door Assemblies
- C. UL - Underwriters Laboratories
 - 1. UL 10C - Positive Pressure Test of Fire Door Assemblies

2. UL 1784 - Air Leakage Tests of Door Assemblies
3. UL 305 - Panic Hardware

D. Accessibility

1. ADA - Americans with Disabilities Act
2. ICC / ANSI A117.1 - Accessible and Usable Buildings and Facilities

E. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware

F. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI A156.31 - Standards for Hardware and Specialties

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: Details of electrified door hardware, indicating the following:

1. Wiring Diagrams: For power, signal, and control wiring and including the following:

- a. Details of interface of electrified door hardware and building safety and security systems.
- b. Schematic diagram of systems that interface with electrified door hardware.
- c. Point-to-point wiring.
- d. Risers.

2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

D. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

- a. Submittal Sequence: Submit door hardware schedule after submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.

- b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
 - c. Format: Use same scheduling sequence and format as in the Contract Documents.
 - d. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - 5) Fastenings and other pertinent information.
 - 6) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for door hardware.
 - 8) List of related door devices specified in other Sections for each door and frame.
2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.
 3. Samples: If requested by the Architect, submit production sample or sample installations as requested of each type of exposed hardware unit in the finish indicated, and tagged with a full description for coordination with the schedule.
 - a. Samples will be returned to the supplier in like-new condition. Units that are acceptable to the Architect may, after final check of operations, be incorporated into the Work, within limitations of key coordination requirements.
 4. Templates: After final approval of the hardware schedule, provide templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware.
 5. Elevation and Wiring Diagrams: After final approval of the hardware schedule, submit elevation and wiring diagrams as required for the proper installation of complete electrical, electromechanical, and electromagnetic products.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Qualification Data: For Installer and Architectural Hardware Consultant.
- C. Product Certificates: For electrified door hardware, from the manufacturer.

1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
- D. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- E. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS
- B. Maintenance Data: For door hardware to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
 1. Warehousing Facilities: In Project's vicinity.
 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- C. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
 1. For door hardware, an Architectural Hardware Consultant (AHC) who is also an Electrified Hardware Consultant (EHC).
- D. Source Limitations: Obtain each type of door hardware from a single manufacturer.
 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.
- F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- G. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- H. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC/ANSI A117.1 and the Connecticut State Building Code.
 1. Provide operating devices 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. Comply with the following maximum opening-force requirements:
 - a. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
 4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- C. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- D. Deliver keys to Owner by registered mail or overnight package service.

1.9 COORDINATION

- A. Prior to ordering hardware, coordinate keying with **Mr. Richard Jankovich, Office of Rails.**
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. WARRANTY

- E. Refer to Form 817 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- F. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
 - a. Locksets: Seven (7) years, except electrified locksets.
 - b. Manual Closers: Lifetime Warranty.
 - c. Butt Hinges and Continuous Hinges: Lifetime warranty.

1.10 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
 - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Stanley
 - b. Hager Hinge
 - c. McKinney Products Company; an ASSA ABLOY Group company

2.3 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
 - 2. Deadbolts: Minimum 1.25-inch bolt throw.
- C. Lock Backset: 2-3/4 inches, unless otherwise indicated.
- D. Lock Trim:
 - 1. Description: As indicated in schedule.
 - 2. Levers: Cast.
 - 3. Escutcheons (Roses): Cast.
 - 4. Operating Device: Lever with escutcheons (roses).
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

2.4 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Trimco
 - b. ABH Manufacturing
 - c. Burns

2.5 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturer: Same manufacturer as for locking devices.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASSA, Inc.; An ASSA ABLOY Group Company.
 - b. Best Access Systems; Div. of Stanley Security Solutions, Inc.
 - c. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - d. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
 - e. Schlage Commercial Lock Division; an Ingersoll-Rand company.
- B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are interchangeable; face finished to match lockset.
- C. High-Security Lock Cylinders: BHMA A156.30; Grade 1; Type ; permanent cores that are removable; face finished to match lockset.
- D. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- E. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.6 KEYING

- A. Temporary 7 pin cores shall be furnished 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 and 10 operating keys are to be forwarded to the Engineer.
- C. Permanent cores will be furnished, keyed, and installed by the State upon completion of the Project. The State will retain the temporary cores.

2.7 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.

2.8 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass, bronze, or aluminum base metal.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Trimco
 - b. ABH Manufacturing
 - c. Burns

2.9 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. National Guard Products.
 - b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
 - c. Reese Enterprises, Inc.

2.10 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. National Guard Products.
 - b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
 - c. Reese Enterprises, Inc.

2.11 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.12 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, pipe and tube railing gates with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
- 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. Do not install surface-mounted items until finishes have been completed on substrates involved.
 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
- F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.
 - 1. Configuration: Provide one power supply for each door opening with electrified door hardware.
- G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.3 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
 - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door

hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.4 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.5 DOOR HARDWARE SCHEDULE

- A. Provide hardware for each door to comply with requirements of Section “Finish Hardware,” hardware set numbers indicated in door schedule, and in the following schedule of hardware sets.
- B. Locksets, exit devices, and other hardware items are referenced in the Hardware Sets for series, type, and function. Refer to the preamble for special features, options, cylinders/keying, and other requirements.
- C. Hardware Sets:

SET #01 - EXTERIOR SINGLE WITH STOREROOM LOCK

3 Hinges	CB199 SERIES AS SPECIFIED	US32D	ST
1 Storeroom Lock	45H-7D15H PATD	626	BE
1 Door Closer	QDC111 BF R	689	SH
1 Kick Plate	KO050 10" X 2" LDW B4E CSK	630	TR
1 Door Stop	1211/1270WV AS REQUIRED	626	TR
1 Perimeter Seal	706 E (HEAD & JAMBS)		NA
1 Door Sweep	C627 A		NA
1 Threshold	8425	AL	NA

END OF SECTION 087100

SECTION 089000 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed, storm class extruded-aluminum louvers.
- B. Related Sections:
 - 1. Section 042113 "Brick Masonry".
 - 2. Section 047200 "Cast Stone Masonry".
 - 3. Section 079200 "Joint Sealants".
 - 4. Section 081113 "Hollow Metal Doors and Frames".
 - 5. Section 233100 "Sheet Metal Work and Accessories".

1.3 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.
- D. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 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 30 lbf/sq. ft. (1436 Pa) acting inward or outward.

1.5 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 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 Verification: For each type of metal finish required.

1.6 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, 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 hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
 - 2. For color-finished louvers, use fasteners with heads that match color of louvers.

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 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.

- F. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Wind-Driven-Rain-Resistant Louver.

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Horizontal Storm-Resistant Louver by Airolite Company, LLC (The); Model SCH401, or approved equal.
 - a. Louver Depth: 4 inches. Refer to drawings for type and locations.
 - b. Blades shall be horizontal, inverted-V type with a center hook and spaced approximately 1" on center.
 - c. Frame and Blade Nominal Thickness: Not less than 0.063 inch min.
 - d. Louver Performance Ratings:
 - 1) Free Area: Not less than 39%.
 - 2) Wind-Driven Rain Performance: Not less than 99.5 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 189 fpm.

2.4 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.5 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Match custom color provided by Architect.

2.6 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. Screening Type: Bird screening.
- B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) 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.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Non-rewirable, U-shaped frames.
- 4.

D. Plastic Mesh (Snow Screen):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Benjamin Updike Homeslick 10mm, or approved equal.
 - a. Location: Provide at all locations with no blank-off panels or ductwork attached.
 - b. Edge Treatment: Provide custom aluminum frame, with corners mitered and with bottom of frame to divert moisture through louver sill drain.
 - c. Frame Finish: Same type of finish applied to louvers, but black color.

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 Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. 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.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 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 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Gypsum board and accessories.
- B. Related Sections:
 - 1. Section 099613 "Interior Epoxy Painting".
 - 2. Section 079200 "Joint Sealants".
 - 3. Section 104116 "Emergency Key Cabinet".

1.3 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. FM Global Listing: Provide gypsum board and component materials that comply with Data Sheet 1-28. The gypsum board within the following zones of the building should be designed to withstand an outward horizontal wind force of 46 psf in the field (Zone 4) and 46 psf in the corners (Zone 5) and an inward force of 49 psf in the field and 58 in the corners of the wall. Identify materials with FM Global markings.
- B. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Gypsum.
 2. CertainTeed Corp.
 3. Georgia-Pacific Gypsum LLC.
 4. USG Corporation.
- B. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, Level 1.
1. Core: 5/8 inch, Type X.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TRIM ACCESSORIES

- A. Trim: ASTM C 1047.
1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
1. Gypsum Board: Paper.
- C. Joint Compound for Exterior Applications:
1. Gypsum Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- G. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 1. Wallboard Type: As indicated on Drawings.
 2. Abuse-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners.
 2. Bullnose Bead: Use at outside corners.
 3. LC-Bead: Use at exposed panel edges.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 1. Level 5: At all exposed locations in public view.
 - a. Primer and its application to surfaces are specified in other Section 099123 "Interior Painting."

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 – 2016, and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Gypsum board.
 - 2. Incidental wood surfaces as indicated on the drawings or as directed by the Engineer.
- B. All painted steel components shall be shop-applied, and are specified elsewhere.
- C. Related Requirements:
 - 1. Section 074650 “Exterior Siding and Trim”.
 - 2. Section 081113 “Hollow Metal Doors and Frames”.
 - 3. Section 099600 "High-Performance Coatings" for special-use coatings.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

- F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product. Include preparation requirements and application instructions.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 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, with the proposed product highlighted.
 - 3. VOC content.

1.5 EXTRA STOCK

- A. Submit the following in accordance with Form 817 Article 1.20-1.08.14, NOTICE TO CONTRACTOR – CLOSING DOCUMENTS for additional information.
- B. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- 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.

1.8 FIELD 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Benjamin Moore & Co.
 2. ICI Paints.
 3. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. 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.
- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
- D. Colors: Custom color to be selected by Architect.

2.3 PRIMERS/SEALERS

- A. Primer, Alkali Resistant, Water Based: MPI #3.
- B. Primer, Bonding, Solvent Based: MPI #69.

2.4 WATER-BASED PAINTS

- A. 100% Acrylic Latex, Exterior Semi-Gloss (Gloss Level 5): MPI #11.

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 the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Wood: 15 percent.
 - 2. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and 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.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

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.
 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. 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 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 Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

- A. Gypsum Board Substrates:
1. Latex System with Alkyd Primer:
 - a. Prime Coat: Primer, Oil-based primer, MPI#7.
 - b. Primer, Alkyd for Exterior Wood: MPI #5 (over manufacturer's shop-applied primer)
 - c. Intermediate Coat: Latex, 100% Acrylic semi gloss.
 - d. Topcoat: Latex, 100% Acrylic semi gloss.
- B. Galvanized-Metal Substrates:

1. Latex System:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Prime Coat: Primer, galvanized metal, as recommended in writing by topcoat manufacturer for exterior use on galvanized-metal substrates with topcoat indicated.
 - c. Intermediate Coat: Latex, exterior, matching topcoat.
 - d. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #119.

C. Aluminum Substrates:

1. Latex System:
 - a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior semi-gloss (Gloss Level 5), MPI #11.

END OF SECTION 099113

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section includes surface preparation, shop application and field touch up of high-performance coating systems on the following substrates:
 - 1. Exterior Substrates:
 - a. Steel.
 - b. Hot Dip Galvanizing
- B. The adverse conditions dictated by work along a operating railroad necessitate the following conditions:
 - 1. All high-performance coatings will be shop-applied.
 - 2. Areas that require field touch-up will be limited to connections and minor abrasions due to erection. Field touch-up is to be applied by the Painting Contractor, certified by the Manufacturer.
- C. Related Sections:
 - 1. Section 051213 "Architecturally Exposed Structural Steel Framing".
 - 2. Section 055213 "Pipe and Tube Railings".
 - 3. Section 099113 "Exterior Painting".
 - 4. Section 055000 "Metal Fabrications".

1.3 DEFINITIONS

- A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- B. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
- C. Samples for Verification: For each type of coating 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.
 - 3. VOC content.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article 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.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Applicator Qualifications: Engage an experienced applicator who has completed high-performance coating system applications similar in material and extent to those indicated for Project and whose work has a record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- 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.

1.7 FIELD CONDITIONS

- A. Apply field touch-up of coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Carboline Company (Carboline).
 - 2. DuPont Company, High Performance Coatings (DuPont).
 - 3. International Protective Coatings; Courtaulds Coatings (International).
 - 4. Tnemec Company, Inc. (Tnemec).
 - 5. The Sherwin Williams Co., (Sherwin Williams)

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each coating 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 coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
 - 3. Provide products of same manufacturer for each coat in a coating system.
- C. Colors: Custom color to be selected by Architect.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

2.3 SCHEDULE OF FINISHES

- A. The Steel Fabricator shall finish structural steel components for high-performance coatings as specified below:

Exterior Exposed Structural Steel Framing including the following components and systems are to receive a triplex finishing system consisting of prime coat and a two-coat shop-applied high-performance coating system.

- a. Exterior platform and stair railings and incorporated systems, sign frames, brackets and fasteners, unless specified as galvanized and to remain unfinished and exposed to view. Refer to Specifications Section 055213 – Pipe and Tube Railings, 055000 - Metal Fabrications.
 - b. Exterior Architecturally Exposed Structural Steel Framing and connections. Refer to 051213 - Architecturally Exposed Structural Steel Framing.
 - c. Exposed tube steel framing and connected miscellaneous steel, including railing systems etc.
1. The following items are hot-dipped galvanized:
 - a. Platform fold-up edge steel system (not including aluminum components). No paint applied over these components.
 - b. Any remaining exterior exposed to weather steel (051200 – Structural Steel Framing) as depicted in the contract drawings.

2.4 EXTERIOR HIGH-PERFORMANCE COATING SYSTEMS

- A. Basis of Design: System specified is based upon a 3-coat priming and finishing system as manufactured by Tnemec, as follows:
 1. Severe Environment (High-Gloss Finish): One finish coat over one intermediate coat and a primer.
 - a. Primer: Tnemec Series 90-97 Zinc @ 2.0-3.5 mils dry. Coordinate with steel fabricator for application, and Section 05120 – Structural Steel for priming and steel preparation.
 - b. 2nd Coat: Tnemec Series 27 Typoxy (color) @ 3.0-5.0 mils dry.
 - c. 3rd Coat: Tnemec Series 73 Endura Shield (color) @ 1.5-3.0 mils dry.
 2. Acceptable Systems:
 - a. Primer: Epoxy primer applied at spreading rate recommended by manufacturer.
 - 1) Carboline: 893 2-Component Cross-Linked Epoxy.
 - 2) DuPont: 25P High Solids Epoxy Mastic.
 - 3) International: Intergard 251 Thin- Film Polyamide Epoxy Rust Inhibitive Primer.
 - b. 2nd Intermediate Coat: Epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 3.0 to 8.0 mils.
 - 1) Carboline: 890 2-Component Epoxy.
 - 2) DuPont: 25P High Solids Epoxy Mastic.

- 3) International: Intergard 345 DTM Semi-Gloss Epoxy.
- c. 3rd Coat: Aliphatic polyurethane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils.
 - 1) Carboline: 134-HS 2-Component Acrylic-Aliphatic Urethane.
 - 2) DuPont: Imron 333 High Gloss Polyurethane Enamel.
 - 3) International: Interthane 990 Low VOC Thin Film Polyurethane.

2.5 SOURCE QUALITY CONTROL

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
 - 1. General Contractor shall procure the services of a qualified testing agency to sample coating materials. Owner will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Testing agency may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

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 the Work.
- B. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 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 hardware, covers, plates, and similar items already in place that are removable and 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.
- C. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning" for Exterior platform railings and incorporated systems, stairs, gates, sign frames, brackets and fasteners
 - 2. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning." For platform, canopy, stair/elevator towers - all steel members including columns, beams, purlins, roof framing components and accessories including base plates.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.
- E. Application Procedures: Apply coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
- F. Brush Application: Use brushes best suited for material applied and of appropriate size for the surface or item being coated.
 - 1. Apply primers and first coats by brush unless manufacturer's written instructions permit using roller or mechanical applicators.
 - 2. Brush out and work brush coats into surfaces in an even film.
 - 3. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.

4. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by manufacturer for the material and texture required.
5. Spray Equipment: Use mechanical methods to apply coating if permitted by manufacturer's written instructions and governing regulations.
 - a. Use spray equipment with orifice size recommended by manufacturer for material and texture required.
 - b. Apply each coat to provide the equivalent hiding of brush-applied coats.
 - c. Do not double back with spray equipment building-up film thickness of two coats in one pass, unless recommended by manufacturer.
- G. Minimum Coating Thickness: Apply each material no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.
- H. Field Connections: Areas adjacent steel field connections to be delivered to jobsite with primer coat only. See Section: "FIELD PAINTING"
 1. Shop-apply primer coat to entire component.
 2. Mask-off areas around field connections after erection and final torque of connection bolts
 3. Touch-up areas of primer coat that have been damaged.
 4. Apply finish coats to components, allowing proper feathering of surfaces to obtain a consistent finish.
- I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by manufacturer, to material required to be coated or finished that has not been prime coated by others.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Recoat primed and sealed substrates if there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat with no burn-through or other defects caused by insufficient sealing.
- J. Completed Work: Match approved Samples for color, texture, and coverage. Remove, refinish, or recoat work that does not comply with specified requirements.

3.4 QUALITY CONTROL

- A. Dry Film Thickness Testing: General Contractor shall procure services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
 1. Contractor shall touch up and restore coated surfaces damaged by testing.
 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 FIELD PAINTING

- A. Summary: Field painting will be limited to connections and minor abrasions from delivery or erection. All other painting is shop-applied.
- B. Restrictions: Train schedules and site conditions may necessitate railroad track outages, railroad flagmen, and nighttime work periods for field painting. The Contractor shall pay special attention to the article entitled, "Safety and Protection of the Railroad Traffic and Property", "requirements for Temporary Protection Shields..." and other Amtrak Specifications in the General Provisions.
- C. Comply with the provisions of Article M.07 of Form 817 except as otherwise stated specified.
 - 1 Clean all steel soon after erection of dirt, mud, lubricant or other foreign matter that may have accumulated.
 - 2. Mask off adjacent painted areas that have already been painted, allowing approximately 1" overlap for feathering.
 - 2. Prime and Spot paint all field bolts, field welds, and abrasions to the shop coat with the same material used for the shop coat. Use a heavy field coat of bituminous paint on those portions of columns to be embedded in masonry or concrete in the exterior walls, and on interior columns through the slab on grade to be encased in concrete.
- D. The ambient air and surface temperature shall be at least 5⁰F above the dew point prior to and during coating applications.

3.6 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

END OF SECTION 099600

SECTION 099610 – GRAFFITI CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 – 2016, and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes: Protective anti graffiti system applied directly to above grade, exterior vertical surfaces indicated, including surface preparation and application.
 - 1. Substrate applications of anti-graffiti include:
 - a. Cast-in-Place Concrete.
 - b. Modular Brick and Mortar.
 - c. Cast Stone.
- B. Related Sections:
 - 1. Section 033000 "Cast-In-Place Concrete".
 - 2. Section 042113 “Brick Masonry”.
 - 3. Section 047200 “Cast Stone Masonry”.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM)

1.4 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data.
- C. M.S.D.S. sheets indicating V.O.C. content and safety pre-cautions.

- D. Pre-Installation Conference Report: Submit report verifying project site conditions, approval of jobsite Mock-Up, manufacturer's instructions and requirements.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Qualification Data: For qualified Installer.
- C. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- D. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 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. Minimum of Five (5) Years experience in the successful application of anti graffiti coating.
- C. Manufacturer Qualifications: Manufacturer with a minimum of Five (5) Years experience in the successful production of anti graffiti technology.
- D. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- E. Mock-Up: Install mock-up (for each material listed above) at project site using acceptable anti graffiti system per manufacturer's instructions. Obtain Engineer/Designer/Owner's approval of system, appearance and workmanship standard. Test a small, remote area to assure desired results. Perform anti graffiti function testing and analysis required prior to installation.
 - 1. Mock-Up Size: Five (5) feet by Five (5) feet (Minimum).
 - 2. Mock-Up Substrate: Vertical Wall.
 - 3. Maintain mock-up during construction for workmanship comparison.
 - 4. Mock-up may be incorporated into final construction upon Engineer/ Architect/Owner's approval.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.8 WARRANTY

- A. Refer to Form 817 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Warranty Period: Manufacturer's standard, but not less than 5-years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide graffiti control products that are compatible with one another and with substrates under conditions of service and application, as demonstrated by the manufacturer, based on testing and field experience.
- B. 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. LymTal, Intl., "Iso-Flex 640 WB"
 - a. Address: 4150 S. Lapeer Rd., Lake Orion, MI 48359 Telephone: 248-373-8100
 - b. Approved Equal
- C. Performance Requirements: Anti graffiti products shall meet or exceed the following performance standards:
 - 1. Percent Active Ingredients - not less than 55%.
 - 2. Flash Point: ASTM D 3278-82 - Results: Greater than 100 degrees F. (SETA C.C.)
 - 3. Pot Life: 1-3 hours
 - 4. Tensile Strength: ASTM D412 – 8000 psi
 - 5. Ultimate Elongation: ASTM D412 – 20%
 - 6. Abrasion Resistance: Tabor 1,000 Rev., CS 17 Wheel, 1000 g – 20 mgs.
 - 7. Impact Resistance: ASTM D2794 – Direct >160 in-lbs, Reverse > 160 in-lbs.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive coatings, with Installer present, for compliance with requirements other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Determine acceptable removal techniques for contaminants harmful to anti graffiti performance, such as dust, dirt, grease, oils, curing compounds, form release agents, laitance, efflorescence, existing films and other water repellent coatings.

3.2 PREPARATION

- A. Protect adjacent work areas and finish surfaces from damage during anti graffiti system installation.
- B. Prior to installation, clean substrates of substances that could impair penetration or reaction of anti graffiti system. Coordinate cleaning and application to avoid contamination of newly treated surfaces.
- C. Substrates shall be clean, dry, sound, and free of contaminants detrimental to anti graffiti system performance.
- D. Remove contaminants by method approved at mock-up.
- E. Allow cleaned, damp, or water soaked surfaces to become dry before installation.

3.3 INSTALLATION

3.4 Apply anti graffiti system to properly prepared surfaces indicated. Apply material within time restrictions after surface preparation as recommended by manufacturer.

3.5 Apply anti graffiti by rolling or brushing techniques recommended by manufacturer to achieve desired function and results.

3.6 Apply anti graffiti material as demonstrated and approved at jobsite mock-up and not less than manufacturer's minimum recommended coverage rate. Coverages of approximately 100 square feet per gallon can be attained depending on substrate porosity, texture and profile. A second coat should be applied within 24 hours of the first coat. Coverage rates of the second coat will be approximately 125 ft/gallon.

3.7 CLEANING

- A. Clean off excess coatings as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of and of products on which coatings are applied.

3.8 PROTECTION

- A. Protect surfaces during and after drying period from contact with contaminating substances and from damage resulting from construction operations or other causes so surfaces are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated coatings immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 099610

SECTION 099613 – INTERIOR EPOXY PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.
 - 1. Steel (Hollow Metal Doors and Frames).
 - 2. Gypsum board (ceiling).
 - 3. Concrete (floor).
 - 4. CMU (walls).
 - 5. Plywood (backer-board)
- B. Related Sections:
 - 1. Section 033000 “Cast-In-Place Concrete” for concrete foundation walls.
 - 2. Section 081113 “Hollow Metal Doors and Frames” for doors and frames.
 - 3. Section 042200 "Concrete Unit Masonry" for concrete masonry walls.
 - 4. Section 092900 “Gypsum Board” for gypsum wallboard.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product. Include preparation requirements and application instructions.
- C. Samples: For each type of paint system and in each color.
 - 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 printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.5 EXTRA STOCK

- A. Submit the following in accordance with Form 817 Article 1.20-1.08.14, NOTICE TO CONTRACTOR – CLOSING DOCUMENTS for additional information.
- B. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 90 deg F unless otherwise permitted by manufacturer's written instructions.
- B. Do not apply coatings 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.
- C. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before starting or continuing coating operation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. 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.

1.8 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace elastomeric coatings that fail within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Water penetration through the coating.
 - b. Deterioration of coating beyond normal weathering.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE SUBSTRATES:

- A. Manufacturers: Basis of design product: Subject to compliance with requirements, provide Florock FloroPoxy Wall System as manufactured by Crawford Laboratories, Inc. or comparable product by one of the following:
 1. BASF Corporation
 2. Behr Process Corporation
 3. Or Approved Equal.
- B. Products: Subject to compliance with requirements, provide product listed in the Finish Schedule for the paint category indicated.
- C. Concrete Substrates:
 1. Epoxy Wall System for vertical wall conditions:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Elastomeric, pigmented, interior, water-based, gloss coating.
- D. CMU Substrates:
 1. Epoxy Wall System for vertical wall conditions:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Elastomeric, pigmented, interior, water-based, gloss coating.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Benjamin Moore & Co.
 2. ICI Paints
 3. Sherwin-Williams Company (The)
 4. Or Approved Equal.

2.3 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. 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.
- C. Colors: As selected by Architect from manufacturer's full range.

2.4 PRIMERS/SEALERS

- A. Primer Sealer, Latex, Interior: MPI #50.
- B. Primer Sealer, Alkyd, Interior: MPI #45.

2.5 METAL PRIMERS

- A. Primer, Alkyd, Anti-Corrosive, for Metal: MPI #79 and MPI#76.

2.6 WATER-BASED PAINTS

- A. Light Industrial Coating, Interior, Water Based, Eggshell (Gloss Level 3): MPI #151
- B. Light Industrial Coating, Interior, Water Based, Semi-Gloss (Gloss Level 5): MPI #153.
- C. Light Industrial Coating, Interior, Water Based, Gloss (Gloss Level 6): MPI #154.

2.7 MATERIALS

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."

- B. Moisture-Vapor Transmission: As recommended by manufacturer, based on testing according to ASTM D 1653.
- C. Material Compatibility:
 - 1. Materials for use within each paint system shall be 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, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- D. Colors: As selected by Architect from manufacturer's full range.
- E. Crack Fillers: Elastomeric coating manufacturer's recommended, factory-formulated crack fillers or sealants, including crack filler primers, compatible with substrate and other materials indicated.
- F. Primer (MPI #20): Elastomeric coating manufacturer's recommended, factory-formulated, alkali-resistant primer compatible with substrate and other materials indicated.
- G. Concrete Unit Masonry Block Filler (MPI #116): Elastomeric coating manufacturer's recommended, factory-formulated, high-performance latex block filler compatible with substrate and other materials indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with manufacturer's requirements for maximum moisture content, alkalinity, and other conditions affecting performance of work.
- B. Begin coating only when moisture content of substrate is 12 percent or less when measured with an electronic moisture meter.
- C. Begin coating no sooner than 28 days after substrate is constructed and is visually dry on both sides.
- D. Verify that substrate is within the range of alkalinity recommended by manufacturer.
- E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- F. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in the "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.
- B. Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - 1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.
 - 2. Perform cleaning and coating application so dust and other contaminants from cleaning process will not fall on wet, newly coated surfaces.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches.
 - 2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
- E. CMU Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- F. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.

3.3 APPLICATION

- A. Apply elastomeric coatings according to manufacturer's written instructions.
 - 1. Use equipment and techniques best suited for substrate and type of material being applied.
 - 2. Coat surfaces behind movable items the same as similar exposed surfaces.
 - 3. Apply each coat separately according to manufacturer's written instructions.
- B. Primers: Apply at a rate to ensure complete coverage.
- C. Block Fillers: Apply at a rate to ensure complete coverage with pores filled.

- D. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats similar to color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- E. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform finish, color, and appearance.
- F. Apply coatings 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.
- G. Apply coatings to prepared surfaces as soon as practicable after preparation and before subsequent surface soiling or deterioration.
- H. Spray Application: Use spray equipment for application only when permitted by authorities having jurisdiction. Wherever spray application is used, do not double back with spray equipment to build up film thickness of two coats in one pass.

3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following testing procedures:
 1. General Contractor shall procure services of a qualified testing agency to sample materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance of materials with product requirements.
 3. Owner may direct Contractor to stop coating application if test results show materials being used do not comply with requirements. Remove noncomplying materials from Project site, pay for testing, and recoat surfaces that were coated with rejected materials. Remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

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 coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities, touch up and restore damaged or defaced coated surfaces.

END OF SECTION 099600

SECTION 104060 –TRASH/RECYCLING RECEPTACLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Trash/recycling receptacles furnished and installed in locations indicated on the drawings.
- B. Related Sections:
 - 1. Section 066100 “Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels”.

1.3 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data.
- C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show mounting details
 - 2. Show details for grounding wire attachment.
 - 3. Show fiberglass lids including for both trash and recycling insert/cut-out.
 - 4. Show all recycling graphics.
- D. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors available.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01. **This is a sole source item and no substitutions will be allowed.**

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. Do not deliver trash/recycling receptacles until platform and canopy work is complete.
- C. Store trash/recycling receptacles in original undamaged packages and containers until ready for installation. Handle with sufficient care to prevent any scratches or damage to the finish.

1.6 WARRANTY

- A. Refer to Form 817 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Warranty Period: Manufacturer's standard, but not less than 3-years from the issuance of the Certificate of Compliance.

1.7 SPARE PARTS:

- A. Submit the following in accordance with Form 817 Article 1.20-1.08.14, NOTICE TO CONTRACTOR-CLOSEOUT DOCUMENTS for additional information.
- B. 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.

Provide one (1) complete unit spare for the trash/recycling receptacles.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Blast Resistant Trash/recycling Receptacles: 30” outside diameter with brushed finish Type 316 stainless steel exterior. Provide full formed fiberglass hinged lid with side cut outs (no top opening) and frangible polyethylene liner. Quantity and location per the platform architectural plans.
- B. Mounting bolt covers: Provide covers that adequately cover bench mounting plates. Finish to match Support pipes.

- C. Finish: Finish on metal to include a rust inhibitor and top coat finish of thermosetting polyester powdercoat that is U.V., chip and flake resistant. Color as specified in the Finish Schedule.

2.2 MANUFACTURERS

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide BlastGard MTR Model 101, by BlastGard International, Inc. (727)592-9400, www.blastgardintl.com. **This is a sole source item and no substitutions will be allowed.**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces with Installer present, for compliance with requirements other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Handle and install trash/recycling receptacles in accordance with manufacturer's recommendations and installation instructions.
- B. Assembly of units to be done in accordance with assembly instructions and hardware provided by manufacturer.
- C. Trash/recycling receptacles should be mechanically secured to platform surfaces with epoxy-set anchor bolts. Coordinate installation of grounding wire with electrical contractor. Refer to trash/recycling receptacle manufacturer's instructions for additional mounting/securing instructions. Coordinate embed depths with precast steel strands. Utilize full release drill and equipment to ensure that no precast strands are jeopardized.
- D. Set trash/recycling receptacles level and true to line, in correct relationship to adjacent materials.

3.3 CLEANING

- A. Clean trash/recycling receptacles with cleaning materials approved in writing by manufacturers.

3.4 PROTECTION

- A. Protect surfaces from contact with contaminating substances and from damage resulting from construction operations or other causes so surfaces are without deterioration or damage at time

of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated trash/recycling receptacles immediately and replace.

END OF SECTION 104060

SECTION 104070 – BICYCLE PARKING RACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 – 2016, and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Metro-North Railroad regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the Notices to Contractor and other specifications in the Contract.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bicycle Parking Racks furnished and installed in locations indicated on drawings.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM)

1.4 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data.
- C. Samples for Verification: For the following bicycle parking rack/s, showing;
 - 1. The color of the powder coat finish. Prepare 2 inch by 3.5-inch powder coat samples (or larger) from the same material to be used to finish the product.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. Store bicycle parking racks in original undamaged packages and containers until ready for installation.
- C. Handle powder coated bicycle parking racks with sufficient care to prevent any scratches or damage to the finish.

1.7 WARRANTY

- A. Refer to Form 817 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Warranty Period: Manufacturer's standard, but not less than 1-year from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide graffiti control products that are compatible with one another and with substrates under conditions of service and application, as demonstrated by the manufacturer, based on testing and field experience.

2.2 MATERIALS

- A. Powder Coating: Triglycidyl isocyanurate (TGIC) powder, a polyester coating.
 - 1. Color as selected by Architect.
- B. Heavy Duty Winder: Rack shall be constructed of ASTM A53, 2" Schedule 40 steel pipe (2-3/8" O.D. x 0.154" thick wall (60.3mm x 3.9mm)) or better. Height is 42" (1066.8mm). Rack shall be a minimum of 42" high to provide proper clearance for parked bicycles.

2.3 MANUFACTURERS

- A. 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. Bike Security Racks, Inc
 - 2. Creative Pipe, Inc.
 - 3. Madrax, Inc.
 - 4. Approved Equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces with Installer present, for compliance with requirements other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Handle and install bicycle parking racks in accordance with manufacturer's recommendations and installation instructions.
- B. Set bicycle parking racks secured to construction, level and true to line, in correct relationship to adjacent materials.

3.3 CLEANING

- A. Clean bicycle racks with cleaning materials approved in writing by manufacturers.

3.4 PROTECTION

- A. Protect surfaces from contact with contaminating substances and from damage resulting from construction operations or other causes so surfaces are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated racks immediately and replace.

END OF SECTION 104070

SECTION 104116 – EMERGENCY KEY CABINET

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.2 SUMMARY

- A. This Section includes all labor, materials, equipment, operations, or methods listed, mentioned or scheduled on the plans and/or herein specified, including all incidentals necessary and required for completion of work under this Section.
- B. Provide and install a recessed Knox Box unit as indicated on project Drawings and as specified herein.

1.3 RELATED SECTIONS

- A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Special Conditions and Division 1 of these Contract Documents.
 - 1. Section 054000, “Cold-Formed Framing”.
 - 2. Section 061600, “Sheathing”.
 - 3. Section 092900, “Gypsum Board”.

1.4 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: Submit manufacturer’s product data, including installation procedures.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- C. Store materials indoors in a clean, dry area in accordance with manufacturer's instructions.
- D. Protect materials and finishes from damage during handling and installation.

1.6 WARRANTY

- A. Refer to Form 817 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Warranty Period: Manufacturer's standard, but not less than 5-years from the issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis-of-Design: Knox Company, 1601 W. Dee Valley Road, Phoenix, AZ 85027, 1-800-552-5669, www.knoxbox.com, or approved equal.

2.2 MATERIALS

- A. Basis-of-Design: Knox Box 3200 Series, Lift-Off Door Mode with Recessed Mounting Kit:
 - 1. Recessed mount with lift-off door and UL listed tamper switches.
 - 2. Exterior Dimensions: Recessed mount flange shall be 7"H x 7"W
 - a. Box dimensions are 4" wide x 5" high x 3" deep.
 - 3. Box and Lock: UL Listed
 - a. Lock shall have 1/8" thick stainless steel dust cover with tamper seal mounting capability; double-action tumblers and hardened steel pins accessed by a biased cut key.
 - b. Box shall have 1/4" plate steel housing and 1/2" thick steel door with interior gasket seal.
 - 4. Finish: Manufacturer's proprietary finishing process.
 - 5. Colors: As selected by Architect from manufacturer's standard options.

2.3 INSTALLATION

- A. Install box in accordance with manufacturer's instructions at location indicated on the Architect's drawings.
- B. Install box plumb and level without warp.
- C. Provide proper support for frames.
- D. Anchor frames securely in place.
- E. Use manufacturer's supplied hardware.
- F. Replace defective or damaged doors or other components as directed by Architect.

2.4 ADJUSTING AND CLEANING

- A. Inspect and adjust locks to operate properly.
- B. Touch-up married finishes with manufacturer supplied paint.
- C. Clean surfaces in accordance with manufacturer's instructions.
- D. Do not use abrasive cleaners.

2.5 PROTECTION

- A. Protect box and finish from damage during construction.

END OF SECTION 099610

SECTION 104250 – SITE WAYFINDING & IDENTIFICATION SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY:

- A. This Section includes the following types of signs:
 - 1. Fabricated Aluminum Post and Panel Signs with Pre-cast concrete footings.
 - 2. Fabricated Station Information Display Case with pre-cast concrete footings and single sided exterior grade display cases.
 - 3. Fabricated Aluminum Post and Panel Signs
 - 4. Aluminum Sign Panels
 - 5. Zinc Sign Panels with Braille
 - 6. Aluminum Regulatory Sign Panels with Applied Reflective Graphics.
 - 7. Aluminum Regulatory Signs, Post Mounted with Applied Reflective Graphics.

- B. Related Sections include the following:
 - 1. Division 3 Section “Cast-In-Place Concrete” for sign foundations.
 - 2. Division 5 Section “Pipe and Tube Railings” for railing mounted panel signs

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division I, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817-2016 and supplemental specifications thereto, shall be a part of this specification.

- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.3 SUBMITTALS:

- A. General: Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR—SUBMITTALS.
 - 1. Product data for each sign type specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes. Provide

certifications that all work has been designed and installed in accordance with ADA requirements.

2. Shop drawings showing fabrication and mounting methods for each sign type. Include plans, elevations, and large-scale sections of typical components. Show anchors, layout, reinforcement, accessories and installation details.
 - a. Provide a measured layout for each sign required and prepare full scale layouts of sample messages showing word and letter spacing.
 - b. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed.
 - c. Additions or modifications to details, which are necessary due to special conditions encountered during the site survey, shall be provided by the Contractor as part of the contract and at no additional cost to the State.
3. Materials List: Submit complete list of all materials proposed to be furnished and installed under this Section, making all submittals and re-submittals in accordance with the provisions of the Contract Documents and submit a notarized Certificate of Compliance.
4. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.
 - a. Submit 4" x 4" color samples of each specified finish including paints, applied vinyl, and aluminum.
 - b. Typical mounting brackets.
 - c. Submit a complete sample alphabet of each typeface and pictogram specified (1" minimum height).
 - d. Submit an 8-1/2" x 11" color print of each specified logotype, to include any modifications as required.
 - e. Catalog Cuts: Catalog cuts shall be marked to indicate the item, model, capacities and other characteristics listed in the table or on printed sheets.
5. As part of Shop Drawing submission provide a detailed schedule of proposed times and dates for the installation of signage. Schedule shall be submitted for review and approval. All work shall be performed in accordance with any modifications affected by train schedule.

1.4 INFORMATION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.5 QUALITY ASSURANCE:

- A. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.
- B. Source Limitations: For each separate sign type required, obtain signs from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- C. Comply with the Department of Transportation ADA Standards for Transportation Facilities — the 2006 DOTAS and all other applicable codes with regard to signage, as well as any and all subsequent appendices, addenda or revisions.
- D. For actual fabrication of the signage package, use only mechanics that are thoroughly trained and experienced in the skills required for the manufacture and fabrication of the units. In acceptance or rejection of the manufactured units, no allowance will be made for lack of skill on the part of the fabricator/manufacturer.
- E. Tolerances:
 - 1. Sign Panels
 - a. The Contractor shall note on the shop drawings all fabrication tolerances including, but not limited to: plumb, thickness, length, width, square-ness, camber, and flat-ness.
 - b. Signs shall be free of defects including, but not limited to: buckles, dents, warps, wrinkles, and burrs.
 - 2. Messages
 - a. Message Location: $\pm 1/16$ inch from the location as shown.
 - b. Line-to-Line: $\pm 1/32$ inch between each line and $\pm 1/16$ inch over entire message.

- c. Letter-to-Letter or Symbol (horizontally and vertically): $\pm 1/32$ inch between each letter or symbol and $\pm 1/16$ inch over an entire line.
 - 3. All sign face panels shall be of a single sheet. Joined pieces will not be accepted.
 - 4. Design components to allow for expansion and contraction for temperatures ranging between -20°F and $+100^{\circ}\text{F}$, without causing buckling, opening of joints, or overstressing of welds and fasteners.
 - 5. Comply with AWS D1.2 for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded joints of all welding flux and dress on all exposed and contact surfaces.
 - 6. Mill joints to a tight, hairline fit. Cope or miter corner joints.
- F. The Contractor shall have all mounting and fabrication details and calculations designed, stamped and approved by a currently licensed Professional Engineer (PE), and reviewed and approved by the Engineer.
- G. Structural Performance: Structural elements shall withstand the effects of gravity, wind, seismic, snow, and ice loads as per the Connecticut State Building Code. At a minimum, the signs must withstand a wind load of 20lbs/sf and horizontal/vertical loads of 250lbs/sf at top center of the sign with a maximum deflection of 1/360 of sign height. Calculations are to be submitted to the Engineer for review.
- H. Manufacturer is to provide a five (5) year unconditional guarantee for said units against any defects in workmanship or fabrication.
- I. The State reserves the right to retain an independent testing service to inspect the manufacturing process to ensure conformity to the Contract Documents.
- J. The Contractor shall have in effect a Quality Assurance (QA) program clearly defining the procedures and requirements necessary to ensure that all aspects of the Work are accomplished in accordance with the Contract Documents. The Contractor will submit a copy of its QA program to the Engineer within fifteen (15) days after receipt of Notice of Award, for review and approval.
- K. Minor deviations from the specifications will be accepted to utilize a manufacturer's standard product only when approved in advance on a shop drawing as a substitution and when in the judgment of the Designer such deviations do not materially detract from the Design Concept or the intended performance.
- L. The Contractor shall be responsible for the quality of all materials and workmanship required for the execution of this contract, including the materials and workmanship of any firms or individuals who act as its Subcontractors. The Contractor shall be

responsible for providing Subcontractors with complete and up-to-date drawings, specifications, message schedules and other information issued by the Designer.

- M. No fabrication or installation materials or methods shall be used that will change the visual quality or in any manner have an adverse effect on existing materials and surfaces. The Contractor is responsible for the structural stability of all signs and mounting there-of. All damaged surfaces and materials shall be restored to their original condition and appearance by the Contractor.

1.6 PROJECT CONDITIONS:

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.
- B. The Contractor shall provide adequate staff to take measurements and notes to determine sign locations and conditions.

1.7 REFERENCES:

- A. American Society for Testing Materials (ASTM)
- B. American Welding Society (AWS) – Structural Welding Code
- C. Americans with Disabilities Act – 1990 and the subsequent Department of Justice *2010 ADA Standards for Accessible Design*
- D. ANSI A-1171-2003 – Specifications for Sign Requirements for the Physically Handicapped.
- E. Americans with Disabilities Act Architectural Guidelines (ADAAG)

1.8 DELIVERY, STORAGE AND HANDLING:

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- B. Deliver signs in factory-fabricated containers or wrappings, which offer proper protection from construction debris and physical damage.
- C. Store items in original wrappings in a clean dry place. Protect from weather, dirt, fumes, and water and other abuses of the environment
- D. Handle carefully to prevent damage, breaking and soiling. Do not install damaged units or components, replace with new.

- E. Replacements: In the event of damage, repair will be subject to the State's discretion as to whether replacement or repair will be the procedure for damaged units, and to be provided by the Contractor at no additional cost to the State.

1.9 SCHEDULE OF MANUFACTURE:

- A. The contractor shall submit a schedule of completion and sequence of delivery. This schedule shall include but not be limited to the following:
 - 1. Preparation of Shop Drawings and review and approval of Shop Drawings.
 - 2. Final approval, manufacture and sequence of delivery, unless otherwise indicated on the approved Construction Schedule.

1.10 DELIVERY OF UNITS:

- A. Contractor shall be responsible for handling and storage. The State shall not be responsible until installed and accepted.

1.11 WARRANTY:

- A. Refer to Form 817, Article 1.20-1.06.08 and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Provide a written warranty issued in the name of the State and jointly signed by the supplier stating that the signs have a guaranteed life of five years against fading, spalling, discoloration, staining, gloss reductions, or rusting from date of substantial performance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with the requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Fabricated Aluminum Post and Panel Signs with Pre-cast concrete footings.
 - a. ID Resources, PO Box 127, Peterborough, NH (603) 924-3371
 - b. Dura Architectural Signs, Long Island City, NY (718) 706-6400
 - c. Advanced Signing LLC, Medway, MA (508) 533-9000
 - 2. Single-sided Exterior Grade Display Cases:

- a. Nelson Harkins, Chicago Illinois, phone 1-800-882-8989
 - b. Tablet & Ticket Company, Chicago Illinois, phone 1-800-438-4959
 - c. Poblocki & Sons, Milwaukee Wisconsin, phone (414) 453-4010
3. Fabricated Aluminum Post and Panel Signs:
- a. Howard Industries, Fairview, PA
 - b. Sign Comp, Comstock Park, Michigan
 - c. Admiral Plastics, Cape Girardeau, Missouri
4. Aluminum Regulatory Sign Panels with Applied Vinyl Graphics
- a. Seton Identification Products, Branford, CT
 - b. Vulcan Signs, Foley, Alabama
 - c. Best Manufacturing Sign Systems, Montrose, Colorado
5. Aluminum Regulatory Signs, Post Mounted with Applied Vinyl Graphics
- a. ID Resources, PO Box 127, Peterborough, NH (603) 924-3371
 - b. Dura Architectural Signs, Long Island City, NY (718) 706-6400
 - c. Advanced Signing LLC, Medway, MA (508) 533-9000

2.2 MATERIALS:

A. Aluminum:

- 1. Aluminum sheet shall be of thickness and sizes shown, constructed of alloy and temper recommended by the aluminum producer or finisher for the type of use and finish indicated with not less than the strength and durability properties specified in ASTM B 209 for 5005-H15, or as noted on drawings.
- 2. Aluminum extrusions shall be of alloy and temper recommended by the manufacturer for the type of use and finish indicated, and with not less than the strength and durability properties specified in ASTM B 221 for 6063-T52 ST, or as noted on drawings.
- 3. All Metal: to be free of stain, warp-age and any defects impairing strength, durability and appearance.

B. Paint:

- 1. Paint system to be low VOC, ultraviolet inhibited aliphatic acrylic polyurethane applied over pretreatment coating and primers, as appropriate for each sign substrate material. All signs are clear coated with low VOC satin clear unless indicated otherwise on design intent drawings. Colors to match as follows.

- a. Satin AMT Blue = Matthews Paint VOC# SVOC1142SP
 - b. Satin Silver = Matthews Paint VOC# MP18073
 - c. Satin Red = Matthews Paint to match PMS# 185
 - d. Satin White = Matthews Paint VOC# SV202SP
 - e. Satin Black = Matthews Paint VOC# SV923SP
 - f. Satin Clear Coat = Matthews Paint VOC# Satin Clear 281228
2. Exact identification of all paints to be noted on the shop drawings, with data describing method of application if other than air drying. Paint finish on signs shall be surface sprayed and have a consistent satin finish, free of dirt, grit, mottling, etc. Each paint coat shall contain ultra-violet inhibitors and shall be applied with sufficient time allowed between applications for proper curing. Provide barrier coats over incompatible primers or remove and re-prime as required.

C. Acrylic:

- 1. Cast acrylic sheet: Provide cast transparent methyl methacrylate monomer plastic sheet with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790 and a minimum allowable continuous service temperature of 80 degrees C. Where sheet material is indicated as "clear," provide colorless sheet in matte finish, with light transmittance of 92% when tested according to the requirements of ASTM D 1003.
- 2. All acrylic panels to be free of stain, warp-age and any defects impairing strength, durability and appearance.
- 3. Finish is to be uniform on face and edges, unless otherwise specified.
- 4. All colored coatings, including inks and paints and films, for copy and background colors, to be of a type recommended by acrylic manufacturers for optimum adherence to acrylic surface and nonfading for the application intended.

D. Opaque Vinyl Lettering:

- 1. All opaque vinyl lettering to be die-cut from opaque, non-reflective vinyl film as manufactured by 3M Co., or approved equal. Vinyl shall have a matte finish with a .003 to .006 thickness and shall match colors indicated on drawings. No hand cut letters will be accepted. Messages to be pre-spaced for application on site. Colors shall be as follows:
 - a. Majestic Blue = Avery Ultimate Cast Opaque Film UC 900-625-O
 - b. Light Silver Metallic = 3M Scotchcal Controltac Film 180C-220
 - c. Perfect Match Red = 3M Scotchcal Electrocut Film 220--263
 - d. White = 3M Scotchcal Electrocut Film 7725-10
 - e. Black = 3M Scotchcal Electrocut Film 7725-12

E. Reflective Vinyl Lettering:

1. Reflective Vinyl Lettering: All reflective vinyl lettering to be 3M Company, or approved equal, engineering grade reflective vinyl with clear pressure sensitive adhesive backing and carry a minimum 5 year material warranty. Letters to conform with the specified typeface. Colors shall be as follows:
 - a. White = 3M Scotchlite Reflective Vinyl 680-10
 - b. Black = 3M 3M Scotchlite Reflective Vinyl 680-85
 - c. Ruby Red = 3M Scotchlite Reflective Vinyl 680-82

F. Mounting Materials:

1. Mechanical Mounting: Corrosion resistant fasteners of a type recommended by the manufacturer for use in the type of substrate encountered at each location.
2. Adhesives: Where adhesive mounting techniques are required, the Contractor shall use adhesives specifically designed for compatibility with the base materials and the desired adhesive strength in accordance with recommendations made by the manufacturer of the materials specified to be laminated or adhered. No adhesives that will fade, discolor or de-laminate as a result of proximity to ultraviolet light source or heat or cold shall be used. No adhesives shall change the color or deteriorate the materials to which they are applied. All adhesives shall be of a non-staining, non-yellowing quality and all visible joints shall be free from air bubbles and other defects. All adhesives shall be tested on site. All adhesives shall be indicated in the shop drawings.

G. Welding:

1. Fabrication shall be accomplished using the highest standards of workmanship. All pieces shall be cut and carefully fit together. All visible connections shall be full welded and ground smooth. All visible surfaces and connections shall be without visible grinding marks, surface differentiation or variation.
2. All metal to be free of stain, warp-age and any defects impairing strength, durability and appearance.
3. All welds to comply with the recommendations of the AWS.

H. Fasteners:

1. Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

I. Anchors and Inserts:

1. Use nonferrous metal or hot-dipped galvanized anchors and inserts as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled

in place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.3 GRAPHIC PROCESS TYPES:

A. Applied Vinyl:

1. All vinyl lettering to be reflective or opaque, as noted on the drawings, and to be die-cut.
2. No hand cut letters will be accepted.
3. Messages to be pre-spaced for application on site.

2.4 GRAPHIC REQUIREMENTS:

A. Typeface: The typefaces shall conform to the type specifications in this sign package. Alternate type will not be accepted. Type for signs shall match Adobe Type Library fonts (Adobe Systems, Inc.):

1. Futura Heavy
2. Futura Bold

B. Letter and Word Spacing: shall be optical but in conformance with the examples shown on the drawings.

C. All Letterforms: shall be aligned to maintain a baseline parallel to the sign format.

D. Letter Size: to be determined by the height of the upper case 'E' of the letterform.

E. Messages: on drawings are for demonstration purposes only. In all cases refer to the Sign Schedule for messages to be used on the finished signs.

F. Symbols are based on the "*System of Passenger/Pedestrian Orientation Symbols*" developed for the Department of Transportation by the American Institute of Graphic Arts and the Society of Environmental Graphic Design's symbols of accessibility.

2.5 FABRICATION:

A. Fabricate Sign Units of graphic process, design, copy, dimensions and color indicated or specified.

B. Copy shall be as stated in message schedule.

1. Confirm "TBD", to be determined, information before fabrication.

C. Artwork:

1. All artwork, unless specifically noted otherwise, shall be the sole responsibility of the Contractor.
2. Where noted on the drawings, the Contractor shall coordinate and obtain from CTDOT, authorized artwork of the Connecticut Commuter Rail logo, for reference only. Creation of production ready artwork is the sole responsibility of the contractor.
3. Full size color proofs of all artwork, printed on high quality paper, to be submitted for approval prior to fabrication.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION:

- A. The locations of signs shown on the drawings are for general information only. It is the responsibility of the Contractor to coordinate with the Owner to determine final locations of signs in the field.
- B. The Designer shall be notified of any discrepancies in the drawings, in field dimensions or conditions and/or changes in construction drawings prior to fabrication and/or installation.
- C. The Contractor shall examine the areas and conditions under which work of this section is to be performed and correct any conditions detrimental to the timely and proper completion of the work.
- D. The Contractor shall not install signs until adjacent finish work is completed.

3.2 INSTALLATION:

- A. Installation of components to be in compliance with manufacturer's instructions, unless otherwise specified.
- B. Signs shall be installed level and plumb with the orientation shown on the drawings, unless directed otherwise by the owner, with sign surfaces free from distortion or other defects in appearance.
- C. Exposed surfaces of fasteners should be field coated with paint to match the surrounding surface color; exposed threads to be protected from paint to allow future maintenance of signs.
- D. Anchor bolts and nuts to be coated with corrosion-resistant grease to allow future maintenance of signs.

- E. Contractor to provide repair and touch up prior to and after punch list inspection.
- F. Contractor to be responsible for the removal of all crating and debris from the project site upon completion.

3.3 CLEANING AND PROTECTION:

- A. After installation, clean soiled sign surfaces according to the manufacturer’s instructions. Protect signs from damage until acceptance by the State.

NHHS/ Windsor Short High-Level

Type	Description	Comments
A1a	Branded City Identifier	
A11a	Station Information Display Case	(CT rail Logo) CTDOT
A11b	Station Information Display Case	(Amtrak Symbol) Amtrak
A11b RELOCATED	Station Information Display Case	(Amtrak Symbol) Amtrak
A12	ADA City Identifier	
B19	Permanent Room Identifier	
C4 RELOCATED	Vehicular Directional (2) Messages	

NHHS/ Windsor Short High-Level

SIGN SCHEDULE

Type	Tag	Level	Message side "A"	Message side "B"	Comments
A1a	A1a-01	PLAT	Windsor (CT rail Logo)	Windsor (CT rail Logo)	Rail Mounted
A1a	A1a-02	PLAT	Windsor (CT rail Logo)	Windsor (CT rail Logo)	Rail Mounted
A1a Count 2					
A11a	A11a-01	SITE	Windsor (CT rail Logo)	Windsor (CT rail Logo)	Post Mounted
A11a Count 1					
A11b	A11b-01	SITE	(Amtrak Symbol) Amtrak Windsor, CT 1-800-USA-RAIL Amtrak.com	(Amtrak Symbol) Amtrak Windsor, CT Thank you for choosing Amtrak. For more information: 1-800-USA-RAIL Amtrak.com	Post Mounted
A11b Count 1					
A11b RELOCATED	A11b-02	SITE	(Amtrak Symbol) Amtrak Windsor, CT 1-800-USA-RAIL Amtrak.com	(Amtrak Symbol) Amtrak Windsor, CT Thank you for choosing Amtrak. For more information: 1-800-USA-RAIL Amtrak.com	Post Mounted
A11b RELOCATED Count 1					
A12	A12-01	PLAT	WINDSOR, CT (Grade 2 Braille)	(none)	Rail Mounted
A12	A12-02	PLAT	WINDSOR, CT (Grade 2 Braille)	(none)	Rail Mounted
A12 Count 2					
B19	B19-01	UTILITY BLDG	AUTHORIZED PERSONNEL (Grade 2 Braille)	(none)	Wall Mounted
B19 Count 1					
C4 RELOCATED	C4-01	SITE	→ (Amtrak Restroom Synbol) Restroom ← (Amtrak Train Synbol) Trains	(none)	Post Mounted
C4 RELOCATED Count 1					

SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 PROVISIONS INCLUDED

- A. Examine all other Sections of the specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.
- B. Coordinate work with that of all other Trades affecting, or affected by work of this Section. Cooperate with such Trades to ensure the steady progress of all work under the Contract.

1.2 DEFINITIONS

- A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.
- B. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.
- C. Wherever the term "provide" is used in the specifications it will mean "furnish" and "install", "connect", "apply", "erect", "construct", or similar terms, unless otherwise indicated in the specifications
- D. Wherever the term "material" is used in the specifications it will mean any product, "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.
- E. The terms "approved", or "approval" shall mean the written approval of the Architect.
- F. The term "specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, except for the drawings.
- G. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed" and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms "approved", "acceptable", "satisfactory" and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms "necessary", "reasonable", "proper", "correct" and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.
- H. "Piping" includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.

- I. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.
- J. "Exposed" means not installed underground or "concealed" as defined above.
- K. "Invert Elevation" means the elevation of the inside bottom of the pipe.
- L. "HVAC, Plumbing, and/or Fire Protection Contractor" shall refer to the Contractor or his Subcontractors responsible for furnishing and installation of all work indicated on the HVAC, Plumbing, and/or Fire Protection drawings and specifications, as applicable and or referenced to each Trade in the Architectural and/or Structural documents.
- M. "Mechanical Contractor" shall refer to the Fire Protection, Plumbing, HVAC and ATC Contractors, as applicable.
- N. "Architect" shall refer to the Architect "Michael Baker International" and/or Engineer "Mott MacDonald" and/or Owner.
- O. "Owner" shall refer to the designated representatives of the Project Owner.
- P. "General Contractor" shall refer to the Contractor(s) performing work under other sections of the Contract Specifications.
- Q. "Commissioning Agent (CA)" shall refer to the party employed by the Owner to witness the demonstration of all systems according to the commissioning plan.

1.3 CODES, STANDARDS AND REFERENCES

- A. All materials and workmanship shall comply with all applicable Codes, Specifications, Local and State Ordinances, Industry Standards and Utility Company Regulations, latest editions.
- B. In case of difference between Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations and the Contract Documents, the Mechanical Contractor, as applicable, shall promptly notify the Architect in writing of any such difference.
- C. In case of conflict between the Contract Documents and the requirements of any Code or Authorities having jurisdiction, the most stringent requirements of the aforementioned shall govern for budgetary purposes. However, no work will proceed until the Architect determines the correct method of installation.
- D. Should any Contractor, as applicable, perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect.
- E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows:
 - 1. National Electrical Code (NEC)

2. Environmental Protection Agency (EPA)
 3. STATE -- Environmental Air Quality Protection Agency
 4. STATE --Building Code/IBC (Latest Adopted Edition), including all adopted STATE -- Supplements
 5. STATE --Energy Code
 6. STATE - Fire Prevention Regulations and Elevator Regulations
 7. Local Ordinances, Regulations of the Local Building Department and Fire Department
 8. (Applies only to Hospitals) Guidelines for Construction and Equipment of hospital and Medical Facilities, as published by A.I.A. Press, ISBN 1-57165-002-4, U.S. Dept. of Health and Human Services
 9. Recommendations of the National Fire Protection Association (NFPA), latest applicable edition adopted, in general and in particular:
 - a. Life Safety, NFPA 101
 - b. HVAC, NFPA 90A, 90B
 - c. Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment, NFPA 96
 10. Recommendations of ASHRAE (American Society of Heating, Refrigeration and Air Conditioning Engineers), including:
 - a. ANSI/ASHRAE 90.1 and 90.2 – Energy Standard for Buildings
 - b. ANSI/ASHRAE 62.1 and 62.2 – Ventilation for Acceptable Indoor Air Quality
 - c. ANSI/ASHRAE 15-Safety Code for Mechanical Refrigeration
 - d. oANSI/ASHRAE 55-Thermal Environmental Conditions for Human Occupancy
- F. In these specifications, references made to the following Industry Standards and Code Bodies are intended to indicate the accepted volume or publication of the Standard. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:
1. AMCA Air Moving and Conditioning Association
 2. ANSI American National Standards Institute
 3. ARI American Refrigeration Institute
 4. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
 5. ASME American Society of Mechanical Engineers

6. ASTM American Society of Testing Materials
7. AWS American Welding Society
8. CS Commercial Standards, U.S. Department of Commerce
9. FM Factory Mutual
10. FS Federal Specification, U.S. Government
11. MSS Manufacturers Standardization Society of the Valve and Fittings Industry
12. NEMA National Electrical Manufacturers Association
13. SMACNA Sheet Metal and Air Conditioning Contractor's National Association
14. UL Underwriters' Laboratories, Inc.

- G. Contractor for the work under his charge, shall give all necessary notices, obtain and pay for all permits, pay all governmental taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. Contractor shall obtain all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work and before final payment is made.
- H. All equipment shall be installed per manufacturer's recommendations and requirements. The Contractor shall notify the Engineer in writing when they intend to deviate from manufacturer's installation guidelines. The Engineer shall advise if the installation is acceptable prior to installation.

1.4 SUBMITTALS

- A. Submit detailed shop drawings or brochures for approval of equipment and material proposed to be used on this project. Furnish the number of copies required by General Conditions.
- B. Documents submitted shall show the following:
1. Principal dimensions and details of construction.
 2. Operating and maintenance clearances.
 3. Weights of principal parts and total weights with information required for the design of supports and foundations.
 4. Sizes and location of piping and connections.
 5. Performance data, including pump and fan curves; sound data including sound power dB levels in 1/3 octave bands.
 6. Data on electric motors, including brake horsepower of driven equipment, nameplate ratings and classes, sound data, starting and running full load currents, required starter size and recommended overload heater ratings.

7. Approval stamp of Underwriters' and other authorities having jurisdiction of Contract Drawings requiring such approval.
 8. Certified performance guarantees.
 9. Calculations and details for refrigeration for field assembled systems including description of specialties and pressure drops, layout of piping with lengths fittings, and refrigerant specialties, and capacity curves for evaporator and compressor showing balance points.
 10. Minimum scale for sheet metal plans and piping plans shall be ¼ inch equal 1 foot.
- C. Submit brochures that contain only that information which is relative to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless irrelevant information is marked out and relevant material is clearly marked.
- D. Specifications Compliance Statement
1. The manufacturer shall submit a point by point statement of compliance with the specifications.
 2. The statement of compliance shall consist of a list of all paragraphs (line by line).
 3. Where the proposed system complies fully, such shall be indicated by placing the word "comply" opposite the paragraph number.
 4. Where the proposed system does not comply, or accomplishes the stated function in a manner different from that described, a full description of the deviation shall be provided.
 5. Where a full description of a deviation is not provided, it shall be assumed that the proposed system does not comply with the paragraph in question.
 6. Submissions which do not include a point by point statement of compliance as specified shall be disqualified.

1.5 GUARANTEE

- A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.
- B. Manufacturers shall provide their standard guarantees for work under this Contract, unless specified otherwise. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and GC / CM may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the various systems, as applicable and as determined by the Architect. The guarantees and warranties will remain in effect for a minimum period of (1) year thereafter except where longer periods are specifically stated and specified.

- C. All materials, items of equipment and workmanship furnished under HVAC, shall carry the warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Contractor responsible, including all other damage done to areas, materials and other systems resulting from this failure.
- D. Contractor shall guarantee that all elements of the systems provided under his Contract, are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated on the drawings.
- E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the responsible Contractor.
- F. Contractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

1.6 THE CONTRACTOR

- A. Contractor shall base his bid on site examinations performed by him. This requirement is mandatory. Contractor shall visit the proposed site where work is scheduled to be performed and ascertain for himself the amount of work required to fulfill the intent of his Contract and the complexity of the installation. Contractor shall not hold the Architect, his Consultants, agents or employees responsible for or bound by, any schedule, estimate or for any plan thereof. Contractor shall study all Contract Documents (HVAC, Plumbing, Fire Protection, Electrical, Communications, Architectural, Structural), etc., included under each Contract, to determine exactly the extent of work to be provided under each Section, and in installing new equipment and systems and coordinating the work with the other Trades and existing conditions.
- B. Contractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications and shall take all responsibility for and bear all losses resulting to him in the execution of his work.
- C. Contractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by Contractor shall perform their work according to all the conditions as set forth in these specifications.
- D. Contractor shall furnish all materials and perform all work in accordance with the project specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. Contractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed.

1.7 COORDINATION OF WORK

- A. Contractor shall compare his drawings and specifications with those of other Trades and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the mechanical or electrical work, to ensure that all work is installed in coordination and cooperation with other Trades installing interrelated work. Before installation, Contractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the work of Contractor caused by his negligence, shall be corrected by him at his own expense, to the Architect's satisfaction.
- B. Locations of piping, ductwork, conduits and equipment shall be adjusted to accommodate the new work with interferences anticipated and encountered during installation. Contractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component. Accurate measurements and coordination drawings will have to be completed to verify dimensions and characteristics of the various systems' installations.
- C. Lines which pitch shall have the right-of-way over those which do not pitch. For example, waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.
- D. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. Contractor shall provide manual air vents and drains as required for his work to affect these offsets, transitions and changes in direction, as applicable.
- E. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, fan shafts and wheels, filters, belt guards, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors, ceiling tiles and cleaning access doors in ductwork.
 - 1. Access to any and all components requiring servicing, adjustment, calibration, maintenance or periodic replacement shall be provided so that the Owner's operations personnel can freely gain access without removal of any materials other than the access panel or ceiling tile. Access shall be understood to mean free, clear and unobstructed from the floor up to the device and/or component being serviced. Fire rated access doors with closers shall be provided for all rated assemblies.
- F. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, ductwork, equipment, terminals and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid

conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom.

- G. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches, electric control components, etc., exist, such conflicts shall be reported to the Architect prior to signing of the Contract. If such action is not taken, Contractor, as applicable, shall furnish such items as part of his work, for complete and operable systems and equipment, as determined by the Architect.
- H. Where drawing details, plans and/or specification requirements are in conflict and where pipe or duct sizes of same pipe or duct run are shown to be different between plans and/or between plans and sections or details, the most stringent requirement will be included in the Contract. HVAC systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.
- I. Final location of all air distribution devices, thermostats, heaters, control devices, etc., shall be coordinated with the Architectural reflected ceiling plans and/or other Architectural details, as applicable. Offsets of ductwork, added sheet metal, fittings, elbows, flexible connections, etc., shall be provided as required to comply with the Architectural reflected ceiling plans and/or installation details. Obtain approval of locations of all devices from Architect in the field, prior to installation.

1.8 COORDINATION DRAWINGS

- A. Before materials are purchased, fabricated or work is begun; Contractor shall prepare coordination drawings for all floors/areas, including buried system/services (all Trade-composite at 1/4" scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements.
- B. Coordination drawings are for the GC / CM and Architect's use during construction and shall not be construed as shop drawings or as replacing any shop drawings. The coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the Architect, corrected and be used to prepare the Record Drawings to be submitted to the Owner for his use.
- C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. This process may include multiple revisions to these drawings which will be included in the cost. The intent is to provide a fully coordinated set of documents between trades no matter how many times they may have to be redone. The HVAC Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (Plumbing, Electrical), so that they can

indicate all their work as directed by the GC / CM and Architect as required, to result in a fully coordinated installation.

- D. In addition to the regular coordination drawing review, the mechanical work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:
- E. Valves and instrumentation should be grouped where possible and positioned in the best accessible locations.
- F. Prepare a complete set of computer based Microstation (Latest Version) drawings at scale not less than ¼" scale equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings. The drawings shall indicate the layout of all specialty tradework as indicated herein and shall be designated as Coordination Drawings. A signed liability release form will be required from the Contractor prior to the release of the disk from the Engineer.
- G. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.
- H. The main paths for the installation or removal of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.
- I. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers and for spaces in the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 6" greater in diameter.
 - 1. Specialty Trade shall include:
 - a. Plumbing system.
 - b. HVAC piping and associated control systems.
 - c. Electrical.
 - d. Sheet Metal Work.
 - e. Automatic Temperature Control
 - f. Fire Alarm
 - g. Security
 - h. Telecommunications
 - i. Commissioning

- J. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.
- K. Where conflicts occur with placement of materials of various trades, the General Contractor shall be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialed and dated by the affected specialty trade Subcontractor. The General Contractor shall then final date and sign each drawing.
- L. Fabrication shall not start until Coordinate Drawings have been distributed to all parties as indicated herein.
- M. Format: Coordination Drawings (plans only) shall be done using Microstation (Latest Version), in either IBM or Mac Format. Disks shall be given to the Architect for future transfer to Owner. Coordination Drawings will be used as base for as-built drawings.
- N. Distribution of Coordination Drawings:
 - 1. The General Contractor shall provide one print of each Coordination Drawing to:
 - a. Each specialty trade Subcontractor.
 - b. Owner.
 - c. General Contractor.
 - d. Architect (for record purposes).
- O. After distribution:
 - 1. Resolve all interference's not previously identified.
- P. Coordination Drawings include but are not necessarily limited to:
 - 1. Structure.
 - 2. Partition/room layout, including indication of smoke and fire resistance rated partitions.
 - 3. Ceiling layout and heights.
 - 4. Light fixtures.
 - 5. Access panels.
 - 6. Sheet metal, heating coils, heat pumps, grilles, diffusers, etc.
 - 7. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.
 - 8. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.
 - 9. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicate

areas in which the required access area may be greater than the suspected grid systems.

10. Existing conditions, including, but not limited to, Mechanical, Plumbing, and Electrical items.

11. ATC panels.

Q. The Architect's response to all requests for information (RFI's) generated by the trade contractors shall be distributed to all other affected trades as if this information was contained in the original contract documents. In other words, the party that issues an RFI is responsible for distributing the information to all affected parties.

1.9 RECORD DRAWINGS

A. Contractor shall maintain, current at the site, a set of Contract Drawings for his portion of the work on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders, requests for information, or other instructions issued by the Architect shall be recorded. Include changes in sizes, location and dimensions of piping, ducts, equipment, etc.

B. Contractor shall indicate progress by coloring-in various pipes, ducts and associated appurtenances exactly as they are erected. This process shall incorporate both the changes noted above and all other deviations from the original drawings whether resulting from job conditions encountered or from any other causes.

C. The marked up and colored up prints will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner's representatives and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory. Marked up drawings shall include all flow diagrams, schedules, details and control diagrams.

D. Contractor shall meet at a minimum on a monthly basis, with the Owner's representative to transfer the information from his HVAC, Plumbing, Fire Protection, etc., marked-up and colored-up prints to a set which will become the basis for preparation of as-built drawings.

E. Upon completion of the project, Contractor shall submit his marked-up drawings to the Architect for review and comment. After the Architect reviews and comments on this set of documents, Contractor shall prepare as-built drawings on CAD using Microstation (Latest Version). When the work is completed, Contractor shall provide 2 hard copies to the Architect for submittal to the Owner and disks with all documentation and a set of reproducible drawing plots marked "As-Built" drawings. The Contractor shall bear all costs of producing the Microstation "As-Built" drawings, providing all necessary drawing changes and printing the reproducible drawings for the work under his charge.

1.10 GIVING INFORMATION

- A. Contractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Contractors [or Subcontractors] sufficiently in advance of the work so that all openings may be built in advance.
- B. The manufacturers listed within this specification have been preselected for use on this project. No submittal will be accepted from a manufacturer other than those specified. Should any Contractor wish to propose a substitution during the bid period, such request shall be made in writing to the Architect, at least (15) working days, prior to bid date. If substitutions are deemed acceptable, such items shall be issued as an Addendum, prior to bid due date. The above requirement is mandatory.

1.11 EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, filters, etc., shall be stored in dry, heated spaces.
- B. Contractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned, polished thoroughly and turned over the Owner in a condition satisfactory to the Architect. Damage or defects developing before acceptance of the work shall be made good at Contractor's expense as applicable.
- C. Contractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.
- D. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should any Contractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.
- E. Contractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.
- F. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of Contractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, Contractor shall

submit drawings showing the proposed installation. If the proposed installation is approved, Contractor shall make all necessary changes in all effected related work provided under other Sections including location of roughing-in connections by other Trades, electrical requirements, piping, supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.

G. Testing Agency Labeling Requirements

1. All equipment and materials required for installation under these specifications shall be new and without blemish or defect.
2. Equipment and materials shall be products which will meet with the acceptance of the Authorities Having Jurisdiction over the work and as specified hereinbefore.
3. Where such acceptance is contingent upon having the FM Global, it shall be provided with FM Global label. Factory manufactured and assembled packaged equipment, such as the examples of equipment listed below, shall have the entire assembled package inspected and Labeled by Factory Mutual.
4. All equipment shall meet OSHA standards.
5. All products shall be listed and labeled by UL or other national testing laboratories such as ETL and the products shall be so labeled.
 - a. Label of Underwriter's Laboratories, ETL or other nationally recognized testing agency acceptable to the Authorities Having Jurisdiction.
 - b. This Labeling shall include not just the control panel and/or motor but all wiring and devices included in the package as a complete package. Note: Providing a series of individually labeled electrical devices that are then assembled into a package does not meet this requirement, the whole assembly must be labeled as an assembly. The manufacturers have the option of having the equipment inspected and Labeled at the factory or at the site after installation. This requirement shall supersede any other specification language hereinbefore or hereinafter that requires only portions of the equipment to be labeled.
 - c. Some examples of packaged equipment requiring Labeling:
 - 1) Exhaust fans,
 - 2) Evaporator units,
 - 3) Condensing units

- H. All equipment of one type (such as valves, fans, air handling units, air terminals, heat pumps, plumbing fixtures, etc.), shall be the product of one manufacturer.

- I. Equipment pre-purchased on behalf of the Owner or by the Owner himself, if assigned to any of the Contractors, shall be received, inspected, installed, etc., as if it was purchased by the Contractors as applicable. All guarantees, service contracts, etc., shall be the same as for all other equipment provided under this Contract.

1.12 CUTTING AND PATCHING

- A. Contractor shall be responsible for all core drilling, as required for work under his Contract, but in no case shall he cut into any structural elements without the written approval of the Architect.
- B. All cutting, rough patching and finish patching, shall be provided under this Contract.
- C. All concrete and masonry equipment bases shall be provided under this Contract.

1.13 USE OF PREMISES

- A. Contractor shall confine all of his apparatus, storage of materials and construction to the limits indicated on the drawings and directed by the Architect and he shall not encumber the premises with his materials.
- B. In storing materials within areas (structure or ground), or when used as a shop, Contractor shall consult with the General Contractor/Construction Manager and shall restrict his storage to space designated for such purposes. Contractor will be held responsible for repairs, patching or cleaning arising from any unauthorized use of premises.
- C. Notwithstanding any approvals or instructions which must be obtained by Contractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain Contractor's. The Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.
- D. Air handling unit or cooling tower sections shall not be used for storage of materials. The HVAC Contractor will be responsible for securing, and maintaining the equipment clean. The above requirement is mandatory.

1.14 PROTECTION/CLEANLINESS

- A. All materials such as valves, fittings, piping, ductwork, plenums, grilles, registers, diffusers, etc., shall be properly protected from the accumulation of dirt, dust, debris or any other contaminants. All ductwork and piping openings shall be temporarily closed by Contractor [or Subcontractor] installing same, so to prevent obstruction and damage, as a minimum at the end of each working day or more often if required by job conditions. Contractor shall take precautions to protect his materials from damage and theft.
- B. Contractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or electrical systems provided under his Contract.

1.15 DAMAGE CORRECTION AND EXTRA WORK

- A. Contractor shall be held responsible and shall pay for all damages caused by his work to the new and existing building structures and new and existing equipment, piping, duct systems, etc., and all work and finishes installed under this Contract in the new or in existing building. Repair of such damage shall be done as herein before specified, at the expense of Contractor and to the Architect's satisfaction.
- B. Contractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or completed. Contractor shall bear all costs of correcting such rejected work.
- C. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.16 TOUCH-UP PAINTING

- A. Contractor shall thoroughly clean all equipment and systems provided under this Contract from rust, splatters and other foreign matter or discoloration, leaving every part of each system in an acceptable prime condition. Contractor, for the work under his Contract, shall refinish and restore to the original condition all equipment and piping which has sustained damage to the manufacturer's prime and finish coats of paint and/or enamel.

1.17 HOUSEKEEPING PADS

- A. Coordinate housekeeping pads for:
 - 1. All equipment indoors or outdoors
- B. Pads shall be 4" above the finished floor.
- C. Each pad shall be a minimum of 6" larger than the equipment, support or isolation base in all directions.
- D. Pads shall be formed, poured with concrete, and tooled by the General Contractor.

1.18 DUCT AND PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRESTOPPING AND SMOKEPROOFING

- A. Where piping and/or ductwork pass through masonry or concrete walls or drywall partitions or floors, Contractor shall provide and set individual sleeves for each pipe or duct and all other work under his charge, as necessary for passage of all pipes and/or ducts. Sleeves shall be of sufficient size to provide 1/2" air space around the pipe or duct passing through (including insulation where pipes or ducts are internally/externally insulated). All openings shall be sealed, smoke proofed and made tight. Contractor shall be responsible for the exact location of sleeves provided under his Contract and shall coordinate all requirements for piping and ductwork sleeves.

- B. Contractor, for work under his charge, shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation.
- C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.
- D. Provide chrome plated brass escutcheons with set screw for exposed piping, in all areas except in mechanical rooms. In this area use plain brass or cast iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to cover sleeved openings for the pipes and of sufficient depth to cover sleeves projecting above floors. Escutcheons shall be as manufactured by Beaton & Caldwell, Dearborn Brass, or Grinnell.
- E. Pipe or duct sleeves shall be made of Schedule 40 pipe, 20 gauge galvanized steel or 16 gauge steel as follows:
 - 1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.
 - 2. Sleeves on ducts passing through concrete construction shall be 20 gauge steel unless required otherwise by item 4. below.
 - 3. Sleeves on pipes or ducts passing through fire rated partitions shall be 16 gauge steel.
- F. Pipe or duct sleeves shall be set as follows:
 - 1. Set sleeves 1" above finish floor, (except set sleeves, 6" above finish floor at penthouses or mechanical rooms and 6" above finished roof) and flush on each side of walls. Coordinate roof penetrations with roof Subcontractor.
 - 2. Sleeves shall be set securely in place before concrete is poured when placed in concrete construction.
 - 3. Provide sheet metal sleeves for all duct penetrations and cover with sheet metal plates all penetrations after ductwork has been installed through walls/floors.
- G. Except as otherwise specified, underground piping passing through exterior walls or foundation slabs on grade, shall have penetration closures of the modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous belt around the pipe and with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall, reducing chances of cathodic reaction between these members. Contractor for work under his charge shall determine the required inside diameter of each individual

wall opening or sleeve before ordering, fabrication or installation. The inside diameter of the wall opening shall be sized to fit the pipe and ensure a watertight joint. Where applicable, when installing seals, take into account the pipe O.D. if non-standard due to coating or jacketing.

1.19 MISCELLANEOUS IRON AND STEEL

- A. Each trade shall provide all primary and secondary steel supports and hangers as shown on the drawings and/or as required to support equipment, ductwork, piping, exhaust fans, or any other materials provided under the work of this Section
- B. The work of this Section of designing, furnishing and installing all miscellaneous metal work associated with the system, and related items as indicated on the drawings and/or as specified herein, and includes, but is not limited to the items listed herein below.
- C. The scope of work shall include:
 - 1. Exhaust fan support platforms including ship ladders, steel grating for decking, cross-bracing and floor stands.
 - 2. Intermediate beams to hang ductwork and piping from the roof. All piping and ductwork must be hung from beam or supported from the floor. Provide supplemental steel for support of equipment.
 - 3. Support of ductwork and piping in shafts in addition to support provided by structure.
 - 4. Support of ductwork via floor stands as required.
 - 5. Piping support in underground concrete trench and manholes.
 - 6. Pipe anchors in the building.
 - 7. Hangers, brackets, angel irons or rods required for the support and protection of HVAC equipment.
 - 8. Field prime painting of galvanized steel and field finish painting.
- D. Shop Drawings for General Miscellaneous Items
 - 1. Submit Shop Drawings of all miscellaneous metal items to Architect for approval, showing sizes and thickness of all members, types of materials, methods of connection and assembly, complete dimensions, clearances, anchorage, relationship to surrounding work by other Trades, shop paint, and other pertinent details of fabrication and installation.
- E. The Subcontractor shall engage the services of a Professional Engineer registered within the state wherein the project is located to prepare complete Design Drawings and structural design computations based on, and closely following, the design and details on the Drawings. The Design Drawings and structural design computations, with the Engineer's seal affixed thereto, shall be submitted to the Architect for review. The structural design computations shall provide a complete structural

analysis, including anchors and fastening devices, and shall certify as to conformation to governing laws and codes. These submittals, upon review, must be sufficient, when taken in conjunction with this Specification to provide the complete basis of the fabrication and erection.

- F. Samples
 - 1. Submit duplicate samples of all materials to be furnished under this Section if, and in size and form, requested by Architect.
- G. Do not order materials or begin fabrication until Architect's approval of submittals has been obtained.
- H. In addition to the governing laws and codes, the following Specifications and Codes form a part of this Specification:
 - 1. American Iron and Steel Institute applicable standards.
 - 2. American Institute of Steel Construction "Code of Standard Practice for Steel Buildings and Bridges" and "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings".
 - 3. American Welding Society Code: Standard Code for Arc and Gas Welding in Building Construction.
- I. All materials shall be new stock, free from defects impairing strength, durability or appearance and of best commercial quality for each intended purpose.
 - 1. Unless otherwise specifically called for, work of this Section shall be fabricated of structural steel conforming to ASTM Specification A36.
 - 2. Steel pipe shall be seamless steel pipe conforming to ASTM Specification A53, Schedule 40.
 - 3. Steel tubing shall be seamless steel tubing conforming to ASTM Specifications A500 to A501.
 - 4. Construction specialties such as slotted inserts, wedge inserts, etc., shall be as manufactured by Hohmann and Barnard, Gateway Erectors, Inc., Richmond Screw Anchor Co. or equal approved by Architect.
 - 5. Non-ferrous metals shall be as specified under descriptions of specific items, herein below.
- J. Provide all anchors, bolts, sockets, sleeves, and other parts required for securing each item of work of this Section to the construction, including furnishing to concrete workers all required insets and sleeves for use at concrete.
 - 1. All exposed fastenings shall be of the same material and finish as the metal to which applied, unless otherwise noted.
 - 2. Welding rods shall conform to AWS Standards and the recommendation of the welding rod manufacturer.

3. Shop primer for other ferrous surfaces shall be a high-quality, lead-free, rust-inhibitive primer, Tnemec No. 10-99 Metal Primer or equivalent by Devoe and Reynolds Co., Carboline or equal.
- K. Metal surfaces shall be clean and free from mill scale, flake, rust and rust pitting. Metal work shall be well formed and finished to required shape and size, true to details, with straight, sharp lines and angles and smooth surfaces. Curved work shall be true radii. Exposed sheared edges shall be eased.
 - L. Weld all permanent connections. Welds shall be continuous on all exposed surfaces and where required for strength on concealed surfaces. Exposed welds shall be ground flush and smooth, with voids filled with metallic filling compound (metallic filling compound not permitted on surfaces to receive hot-dip galvanizing). Tack-welding will not be permitted unless specifically called for. Do not use screws or bolts where they can be avoided. Where used, heads shall be countersunk, screwed up tight, and threads nicked to prevent loosening.
 - M. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Joints exposed to weather shall be formed to exclude water.
 - N. Do all cutting, punching, drilling and tapping required for attachment of anchor bolts and other hardware and for attachment of work by other Trades. All such cutting, punching, drilling, etc., shall be done prior to hot-dip galvanizing of the various components.
 - O. Live loads shall be not less than the minimum required by law. Where specific live load are not set forth in the laws and codes applicable to this work, and are not given on the Drawings or in this Specification, designs shall be such as to support the live loads which may normally be imposed without failure, without deflection of more than 1/360 of length of any member, and without permanent deformation, all with a factor of safety of not less than 2 1/2 to 1.
 - P. Shop Painting
 1. All ungalvanized ferrous metals under this Section shall be given a shop coat of rust inhibitive primer of type specified above.
 - a. Immediately before shop painting, remove all rust, loose mill scale, dirt, weld flux, weld spatter, and other foreign material with wire brushes and/or steel scrapers. Power tool clean in accordance with SSPC SP-3 (Power Tool Cleaning). Remove all grease with oil by use of solvent recommended by paint manufacturer. Sandpaper exposed surfaces as required to produce smooth, even finishes.
 - b. Apply paint by spray process in strict accordance with manufacturer's printed instructions to uniform thickness(es) recommended by manufacturer. Apply thoroughly and evenly and work well into corners and joints taking care to avoid sags and runs.

- c. Do not paint surfaces to be embedded in concrete, or to be welded in the field. After field welds are complete, grind smooth and flush, thoroughly clean and then apply specified primer over all unprimed in the field by brush roller.
- d. After erection, sand smooth and retouch all portions of the shop coats chipped or damaged during erection, and coat all field welds and connections with primer equivalent to that used for the shop coat.

Q. Installation

- 1. All materials shall be carefully handled and stored under cover in manner to prevent deformation and damage to the materials and to shop finishes, and to prevent rusting and the accumulation of foreign matter on the metal work. All such work shall be repaired and cleaned prior to erection.
- 2. Work shall be erected square, plumb and true, accurately fitted, and with the tight joints and intersections. All anchors, inserts and other members to be set in concrete or masonry shall be furnished loose by this Trade to be built-into concrete and masonry and by those Trades as the work progresses. Later cutting or drilling shall be avoided wherever possible.
- 3. All metal work shall be rigidly braced and secured to surrounding construction, and shall be tight and free of rattle, vibration, or noticeable deflection after installed.
- 4. Where members, other than expansion bolts or inserts, are fastened into concrete, set such members in holes formed as specified below, and secure permanently in place by installation of proprietary-type expanding grout manufactured specifically for such purpose, used strictly in accordance with manufacturer's directions. Holes to receive members shall be formed with galvanized sheetmetal sleeves, expanded polystyrene foam, or other approved method to provide at least 1/2 inch clearance around entire perimeter. At exposed applications, hold expanding grout back 1/2 inch from finish surface and fill voids with Portland cement grout to match color and texture of surrounding concrete surface.
- 5. Electrolytic Isolation
 - a. Where dissimilar metals are to come into contact with one another, isolate by application of a heavy coating of bituminous paint on contact surfaces in addition to shop coat specified above. Do not permit the bituminous paint in any way to remain on surfaces to be exposed or to receive sealant.

R. Description of Major Items

- 1. The items described below constitute the major part of the work of this Section, but are not intended or implied to cover each and every item that

may be required to properly complete the work. Carefully review the Drawings to determine the full extent of the miscellaneous metal work required.

S. Steel Ladders/Platforms

1. Fabricate and install interior steel ladder at fans, air handling units, filter racks and all equipment requiring service. Ladders shall have a safety cage as required by OSHA regulations.
2. Except as may be otherwise indicated on the Drawings, ladder shall be minimum 16 inches wide, fabricated of minimum 3/8 inch by 2 1/2 inches hot rolled steel rails and minimum 3/4 inches outside diameter steel pipe rungs. Rungs shall be spaced 12 inches on center and shall be continuously welded to the rails. Provide a pair of steel clip angles or wall brackets at bottom and steel anchor plates or wall brackets at top, welded to the rails, as indicated.
3. Exterior steel ladders shall be hot dip galvanized after fabrication as specified hereinbefore. Rungs are to have non-slip surfaces.
4. All shall be OSHA and ANSI compliant.

T. Gratings and Frames

1. Fabricated and install steel gratings and frames at fan platforms.
2. Steel grating frames shall consist of a steel angle perimeter frame constructed of steel angles, at least 4 inches by 4 inches by 3/8 inches carried around perimeter with coped or mitered, full-welded corners. Perimeter frames shall be anchored with 7/16 inch minimum diameter expansion bolts or other suitable devices of adequate capacity, at corners, two (2) per beam end, and spaced not more than 2 feet on center around full perimeter.
3. Steel Gratings shall be pressure-locked type, with bearing bars spaced 1 3/16 inch on center and cross-bars spaced 4 inches on center. Sizes of bars shall be as required by manufacturer's loading tables to limit deflection of any member across any span to 1/240th of the span at live load of 100 pounds per square foot. Gratings shall be as manufactured by Borden Metal Products, Co., Irving Subway Grating Co., Reliance Steel Products Co., approved by Architect.
4. All (gratings and) frames shall be hot-dip galvanized after fabrication as specified hereinbefore (aluminum, FRP).

U. Miscellaneous Items

1. Carefully review all Drawings for miscellaneous metal items required but not specifically listed above, such as miscellaneous steel clip angles, miscellaneous steel bracketing, and other miscellaneous metal items as

indicated on the Drawings, reasonably implied therefrom, or reasonably necessary for the thorough completion of the work.

2. Provide rigid and secure anchorage of all components whether or not specifically described in complete detail on the Drawings.
- V. Piping supports shall be coordinated with the building structure and shall span between roof beams as required.

1.20 WATERPROOFING, FLASHING AND COUNTERFLASHING

- A. Unless specifically indicated otherwise on the drawings, Contractor shall provide all counterflashing and waterproofing of all piping, ductwork and equipment provided by him, which pierce roofs, walls and other weatherbarrier surfaces. All work under this paragraph shall be coordinated with the GC / CM.
- B. All work shall be performed in a workmanlike manner to ensure weatherproof installation. Any leaks developed due to Contractor's work shall be repaired at his expense, to the Architect's satisfaction.
- C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked waterproof fire stopping. The top and the bottom shall be sealed with monolastic caulking compound.
- D. All flashing required for ductwork and piping penetrations shall be provided by the GC / CM.

1.21 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

- A. See Divisions 26, 27 and 28 for Electrical.

1.22 IDENTIFICATION OF MATERIALS

- A. See section 230553

1.23 VALVE TAGS, NAMEPLATES AND CHARTS

- A. See Section 230553.

1.24 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

- A. Contractor shall thoroughly instruct the representative(s) of the Owner, to the complete satisfaction of the Architect, in the proper operation of all systems and equipment provided by him. Contractor shall make arrangements, via the GC / CM as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the periods of time in which they are to be given. The Architect shall be completely satisfied that the representative of the Owner has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by Contractor to the Owner's representative, then Contractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this paragraph of the

specification has been complied with. All time required for Owner's instruction to satisfy the above requirements shall be included in this Contract. No extra compensation for such instructions will be allowed.

- B. Contractor, including but not limited to, the HVAC Contractor, shall submit to the Architect for approval, a total of (6) typed sets, bound neatly in loose-leaf binders, of all maintenance and operating instructions for the installation, operation, care and maintenance of all equipment and systems. All data and literature furnished shall be specific for the make and model of the equipment furnished. General non-specific catalog data will not be acceptable. Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section such as fans, valves, plumbing fixtures, hot water heaters, boilers, air handling units, etc., shall be clearly divided from the other sections. A sub-index for each section shall also be provided. The methodology of setting-up the manuals shall be submitted to the Architect and Owner through the General Contractor for approval prior to final submission of manuals.
- C. The instructions shall contain information deemed necessary by the Architect.

1.25 MANUFACTURER'S REPRESENTATIVE AND COMMISSIONING OF SYSTEMS

- A. Contractor shall provide, at appropriate time or as directed by the Architect, the on-site services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment provided under his Contract, such as for the air handling units, automatic temperature controls, etc., provided under this Contract, to instruct the Owner, inspect, adjust and place in proper operating condition any item provided by him, as applicable.
- B. The HVAC Contractor, as applicable, shall commission and set in operating condition all major equipment and systems, such as exhaust fan, split type heat pump systems, etc., in the presence of the applicable equipment manufacturer's representatives, and the Owner and Architect's representatives. In no case will major systems and equipment be commissioned by any of the Contractor's forces alone, without the assistance or presence of the equipment manufacturers.
- C. A written report shall be issued by the particular equipment manufacturer and the Mechanical Contractor summarizing the results of the commissioning and performance of each system for the Architect's record. No additional compensation will be allowed for any Contractor for such services.
- D. The Contractor shall prepare and submit to the Architect for acceptance, a schedule of anticipated system commissioning. No system shall be commissioned without prior acceptance of the schedule by the Architect and Owner. No systems shall be commissioned prior to submittal and acceptance of Operation and Maintenance Manuals.

1.26 CONNECTIONS TO EQUIPMENT

- A. Contractor shall provide all duct and/or pipe connections, condensate traps, drains, overflows, relief valves and vents, power connections, etc., to make equipment operable, as provided under other Sections of the specifications, as shown on the Architectural and/or each Trade's drawings and herein specified, including final connections to equipment to result in a complete system, fully operational. Coordinate location of all equipment with Architect. Obtain installation diagrams and methods of installation of all equipment from manufacturers. Follow instructions strictly. If additional information is required, obtain same from Architect. If equipment is indicated on the Architectural drawings, it shall also be construed and understood by the Mechanical Contractor to be constructed as shown on the HVAC drawings and shall be fully serviced and connected at no extra cost to the Owner.

1.27 HOISTING EQUIPMENT AND MACHINERY

- A. All hoisting equipment and machinery required for the proper and expeditious prosecution and progress of the work under this Contract shall be furnished, installed, operated and maintained in safe condition by Contractor for his material and/or equipment delivered to the designated hoisting area. All costs for hoisting operating services shall be borne by the Mechanical Contractor for all equipment and work under his charge.

1.28 STAGING

- A. All staging, exterior and interior, required to be over 8'-0" in height, shall be furnished and erected by Contractor for work under his charge and maintained in safe condition by him for proper execution of his work.

1.29 CONTROL WIRING

- A. The ATC Contractor shall provide all control and interlock wiring for all systems provided under the HVAC, plumbing and ATC Contracts.
- B. All control wiring shall be installed in conduit and in accordance with the respective equipment manufacturer's requirements, and all connections shall be provided by the HVAC/ATC Contractor. All conduit and wiring provided by these Contractors shall be installed in accordance with the requirements of Section 26 of the specifications.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION 230500

SECTION 230529 - HANGERS AND SUPPORTS
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all hangers, supports and assemblies for all parts of the mechanical systems. This shall include all piping, ducts and equipment specified in this Division and as shown on the drawings.
- B. All materials shall be new and manufactured for the specific purpose of supporting systems, equipment, pipes, ducts, conduits and accessories.
- C. Secure all permits and local/state approval for the components as specified and included under this Section.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
 - 1. Material standards shall be as specified or detailed hereinafter and as following:
 - 2. ASME B31.9 – Building Services Piping, The American Society of Mechanical Engineers.
 - 3. ASME B31.1 – power piping.
 - 4. ASHRAE Systems and Equipment Handbook.
 - 5. ASTM F 708 – Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 6. MSS SP-58 – Pipe Hangers and Supports – Materials, Design and Manufacture; Manufacturers Standardization Society of the Valve and Fittings Industry.
 - 7. MSS SP-69 – Pipe Hangers and Supports – Selection and Application; Manufacturers Standardization Society of the Valve Fittings Industry.

8. MSS SP-89 – Pipe Hangers and Supports – Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry.
9. NFPA-13 – Installation of Sprinkler Systems
10. MSS-SP-127-2001 – Bracing for Piping Systems.

1.5 SYSTEM DESCRIPTION

- A. In addition to special hangers and supports specified elsewhere in this Section and shown on the drawings for ducts, piping and equipment, furnish and install safe and substantial means of support for all parts of the mechanical systems. Shop drawings shall be submitted for review and approval for all supports. All piping, ductwork, exhaust pipe and breeching hangers and supports in all mechanical rooms, penthouses and energy plant shall be installed with vibration isolators and Seismic restraints. This requirement is mandatory and shall be strictly enforced.
- B. All piping shall be hung to true alignment, using appropriate and substantial hanger arrangements. Wire and strap hangers will not be permitted. Hangers shall be located so that piping and hangers will be clear of other piping, hangers, conduits, lighting and other obstructions.
- C. The hanging and supporting of piping and equipment shall conform to recommendations of the manufacturers of same and American National Standard, ANSI/MSS SP-58 and SP-69 latest edition, except where requirements of this specification exceed the above referenced Standards.

1.6 SUBMITTALS

- A. See Section 230500 and General Conditions for Additional Requirements.
- B. All brackets and hangers shall be submitted for review. Include the method of hanging and supporting all piping, ductwork and equipment.
- C. The Architect is to be notified when the first bracket is assembled so that the installation can be reviewed in the field.
- D. Provide location of all inserts to be used for hanging ductwork, piping and equipment and the weight of all components (including water weight).

1.7 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products of the type specified in Part 2 – Products.
- B. Installer: Company specializing in performing work of the type specified in this section, with documented experience.
- C. Welders: Certify in accordance with ASME.

1.8 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping system and supports.
- B. Conform to ASME B31.1 code for power piping.

- C. All applicable seismic codes.
- D. ASTM F708 for design and installation of pipe hangers..
- E. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations
 - 1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.9 DELIVERY, STORAGE AND HANDLING

- A. All hangers and supports shall be delivered in containers and shall be kept in a dry and protected area.
- B. All exposed hangers, supports, etc. shall be given 2 coats of rust resistant paint of a color selected by the Architect prior to installation.

1.10 ENVIRONMENTAL

- A. Do not paint or install inserts, hangers and/or supports when environmental conditions are outside the specific limitations of the referenced codes and manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Pipe supports shall be of type and figure number as specified.
- B. Acceptable manufacturers subject to compliance with the specifications shall be as follows:
 - 1. Pipe Hangers
 - a. Carpenter & Patterson
 - b. B-Line
 - c. Grinnell
 - d. National Pipe Hanger Corp.
 - e. Piping Technology & Products Inc.
 - f. PHD Manufacturing, Inc.
 - 2. Constant Force Hangers
 - a. Anvill International, Inc.
 - b. Piping Technology & Products Inc.
 - c. Piping Accessories, Inc.
 - d. Rilco Manufacturing Co.
 - e. PHD Manufacturing, Inc.

3. Channel Support Systems
 - a. B-Line Systems, Inc.
 - b. Grinnell Corp. Power-Strut Unit
 - c. GS Metals Corp.
 - d. Michigan Hanger Co., Inc. O-Strut Div.
 - e. National Pipe Hanger Corp.
 - f. Thomas & Betts Corp.
 - g. Unistrut Corp.
 - h. Wesanco, Inc.
4. Thermal-Hanger Shield Inserts
 - a. Carpenter & Patterson, Inc.
 - b. Michigan Hanger Co., Inc.
 - c. PHS Industries, Inc.
 - d. Pipe Shields, Inc.
 - e. Rilco Manufacturing Co., Inc.
 - f. Value Engineered Products, Inc.

2.2 PIPE HANGERS

- A. Bracket assemblies for supporting piping are to be fabricated by welding and all irregular surfaces are to be smoothed up by grinding. Shop drawings shall be submitted for review for each type bracket. The Architect is to be notified when the first bracket is assembled so that installation can be reviewed in the field. Exposed hangers, supports and brackets are to be given (2) coats of rust resistant paint of the color as selected by the Architect. Additionally, provide for Architect's review, the following:
 1. Location of all inserts to be used for hanging ductwork and piping where applicable and the weight of such pipe or equipment to be hung, including the weight of water, valves and insulation.
 2. Method of hanging and support of all piping, ducts and other equipment.
- B. All pipe supports shall be of type and arrangement as hereinafter specified. They shall be so arranged as to prevent excessive bending stresses between supports.
- C. All bracket clamp and rod sizes indicated in this specification are minimum sizes only. This Section shall be responsible for structural integrity of all supports. All structural hanging materials shall have a safety factor of (5) built in. Beam clamps shall be 2-sided steel clamps designed to firmly attach to the flange of the beam with the load directed downward on the centerline of the beam web. Beam clamps shall be similar to B-Line #B3055, or approved equal.

- D. Other forms of hangers and supports shall be used to accommodate special or unusual job conditions or conditions not covered herein, subject to the approval of the Architect. When special conditions require the use of concrete inserts which are not "built in", such inserts may be used in locations approved by the Architect and shall be Phillips "Red Head" or approved equal. Explosive powder studs or detonator assisted studs or anchors will not be permitted.
- E. All pipes shall be hung free of dependence on pipe sleeves for support.
- F. All auxiliary steel required for pipe, duct and equipment supports shall be furnished and installed by the Mechanical Contractor.
- G. Threaded pipe, chains, wire and perforated straps will not be accepted. No piping shall be supported from ductwork, conduit or other piping. All system components and equipment shall be independently supported. Distribute hangers on parallel piping to avoid overloading of structure.
- H. Constant force support hangers shall be provided for the emergency generator exhaust piping as determined by the stress and seismic analysis. Constant force hangers shall be similar to Anvil International, Inc. and they shall be pre-engineered to meet the loads and expansion for the vertical risers and off sets if any.
- I. Hangers and supports used for systems exposed to weather shall be hot dipped galvanized in accordance with ASTM A153-73 or A123. Rods and nuts shall be electro-galvanized.
- J. All horizontal water, drain, waste, vent and rainwater piping shall be hung with clevis steel hangers similar to B-Line #B3100. Groups of pipes in the same horizontal plane and with the same pitch may be supported on B-Line #3160 gang hangers. Wall brackets similar to shall be B-Line #B3066 and #B3077.
- K. All pipes which are hung so that the centerline of the pipe is less than 10" below the point of suspension of the hanger rod and all hydronic hot water piping shall be supported on roller hangers similar to B-Line #B3110.
- L. Unless otherwise noted, maximum hydronic pipe hanger spacing shall not exceed the recommendations of the pipe manufacturer and the following:
 - 1. For 1/2" copper pipe: 5'-0" o.c.
 - 2. For pipe 3/4" to 1 1/2": 8'-0" o.c.
 - 3. For pipe 2" to 8": 10'-0" o.c.
 - 4. For pipes 10" and up: 15'-0" o.c.
 - 5. In addition, hangers shall be installed within 2'-0" of each change in direction and on each side of valves 3" in size and up.
- M. Hanger rods shall be of steel and not less in diameter than:
 - 1. For pipe 2" and under: 3/8"
 - 2. For pipe 2 1/2" and 3": 1/2"

3. For pipe 4" and 5": 5/8"
 4. For pipe 6": 3/4"
 5. For pipe 8", 10" and 12": 7/8"
 6. For pipe 14" and 16": 1"
 7. For pipe 18" and up: 1 1/4"
- N. Insulated piping 2" and under, except chilled water, shall be fitted with 16 gauge steel covering protectors at each hanger location similar to B-Line #B3151.
- O. Chilled water piping shall be insulated with high density hydrous calcium silicate shields where hangers occur similar to #B3380CW. Special care shall be exercised to assure a continuous vapor barrier installation to protect the system and prevent sweating.
- P. All vertical piping shall be supported with steel riser clamps similar to B-Line #B3773. Such clamps on copper tubing shall be applied over couplings only.
- Q. All pipes suspended at an elbow shall be hung using plate lugs similar to Grinnell #HS.53 with forged steel clevis similar to B-Line #B3201.
- R. Spring hanger locations shall be provided as specified herein, under vibration isolation, and shall be Grinnell, pre-engineered to meet loads and movements in accordance with ANSI B.31.1.10, where applicable.
- S. Drop rods for hangers may be used wherever possible and shall be installed prior to slabs being poured. Drop rod details shall be submitted to the Architect and Engineer for review.

2.3 DUCT HANGERS

- A. See Specification 233100 Sheet Metal

2.4 MISCELLANEOUS MATERIALS

- A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Structural Steel: ASTM A 36M, steel plates, shapes, and bars, black and galvanized.
- C. Grout: ASTM C 1107, Grade B, factory-mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
1. Characteristics: Post hardening and volume adjusting recommended for both interior and exterior applications.
 2. Properties: Nonstaining, noncorrosive and nongaseous
 3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 PREPARATION

- A. All hangers, rod and supports shall receive two (2) coats of rust inhibitive paint.
- B. Provide inserts for placement in concrete formwork.
- C. . Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- D. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- E. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.2 INSTALLATION

- A. Pipe Hangers and Supports
 1. Install in accordance with ASME B31.9, ASTM F 708, or MSS SP-89 or NFPA-13.
 2. Support piping, ductwork and equipment as specified under Part 2.
 3. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.
 4. Place hangers with 24 inches of each horizontal elbow and on each side of valves 3” in size and up.
 5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 8. Provide copper plated hangers and supports for copper piping or between hanger support and piping.
 9. Prime coat (2 coats rust inhibitive paint) exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 10. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- B. Where pipe support members are welded to structural building framing, scrape, brush clean and apply two coats of zinc rich primer to welds.

3.3 INSERTS

- A. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

- B. Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 4 inch or ducts over 60 inches wide.
- C. Finish inserts, flush with slab surface.
- D. Inserts: Steel, slotted type, factory-painted.
 - 1. Single rod: Similar to Grinnell Figure 281.
 - 2. Multi-rod: Similar to Carpenter and Paterson 1480 Type 1.
 - 3. Clip form nails flush with inserts.
 - 4. Maximum load 75 percent of rating.

3.4 SUPPORTS FROM BUILDING CONSTRUCTION

- A. Inserts, Beam Clamps, Steel Fishplates (in concrete fill only), Cantilever Brackets or Other Means.
- B. Submit for Review.
- C. Grouped Lines and Services
 - 1. Trapeze Hangers fabricated of Bolted Angles or Channels.
- D. Where Building Construction is Inadequate
 - 1. Provide Additional Framing.
 - 2. Submit for Review.

3.5 EXPANSION DEVICES

- A. Expansion anchors: Similar to Hilti "Drop-In Anchor HDI" flush type.
- B. Drill concrete to receive required expansion cases on concrete fasteners.
- C. Install in shear only, not in tension.

3.6 EQUIPMENT BASES AND SUPPORTS

- A. Provide rigid anchors for ducts and pipes immediately after vibration connections to equipment.
- B. Refer to Specification Section 15001 for additional information.
- C. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- D. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.7 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- 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 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 contours of welded surfaces match adjacent contours.

3.8 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.9 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 a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230553 – MECHANICAL IDENTIFICATION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install nameplates, valve tags, valve charts, stencils and pipe markers on all Mechanical equipment, piping and ductwork.
- B. Provide nameplates with the unit number and service designation on all mechanical equipment.
- C. Indicate all valve tag numbers on Record Drawings and submit framed under glass valve tag charts including valve service and location.
- D. Provide underground plastic pipe markers 6 to 8 inches below finish grade, directly above buried pipes.
- E. Provide manufactured pipe and ductwork identification stencils with flow arrows and service indicated. All backgrounds of the stencils shall be color coded with specific service designation
- F. Prepare valve charts and frame under glass. All valves and the tag numbers shall be shown on the Record As-Built Drawings.
- G. Provide valve computer data base to match chart.
- H. Prepare and install exterior protected brass plaques indicating underground service entrances.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. ASME A 13.1 – Scheme for Identification of Piping Systems; The American Society of Mechanical Engineers.

1.4 SUBMITTALS

- A. See Section 230500 and General conditions for Additional Requirements.
- B. Product Data: Submit product description including materials, attachment methods, color coding and lettering sizes.

1.5 QUALITY ASSURANCE

- A. All materials, lettering and individual system color coding schemes shall be uniform and of one single manufacturer.
- B. No identification shall be installed until all systems are complete and insulated.
- C. All surfaces shall be cleaned.
- D. No nametag or identification shall break or penetrate a surface used as a vapor barrier.

1.6 REGULATORY REQUIREMENTS

- A. Conform to all local/state and NFPA requirements for color-coding or painting of systems, piping or equipment related to Life Safety or Fire Protection.

1.7 DELIVERY, STORAGE AND HANDLING

- A. All identification systems shall be stored in sealed containers in suitable locations to keep the containers and contents dry and clean.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. All surfaces shall be cleaned and dry before applying any form of identification or tagging.
- B. Consult with the manufacturer prior to installation for the proper tagging and identification procedure and materials to be used on exterior outdoor equipment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Acceptable manufactures contingent on compliance with the specification.
 - 1. Seton
 - 2. W. H. Bradey Company
 - 3. Marning Services Incorporated

2.2 PIPE IDENTIFICATION AND VALVE TAGS

- A. All piping, except that piping which is within inaccessible chases, shall be identified with smi rigid plastic identification markers equal to Seton Setmark pipe markers.
 - 1. Direction of flow arrows is to be included on each marker.
 - 2. Each marker background shall be appropriately color coded with a clearly printed legend to identify the contents of the pipe in conformance with the "Scheme for the Identification of Piping Systems" (ASME A13.1-1981).
 - 3. Setmark snap-around markers shall be used for overall diameters up to 6" and strap-around markers shall be used above 6" overall diameters.

4. Markers shall be located:
 - a. Adjacent to each valve
 - b. At each branch
 - c. At each cap for future
 - d. At each riser takeoff,
 - e. At each pipe passage through wall (each side)
 - f. At each pipe passage at 20' – 0" intervals maximum.
 5. Under ground pipe markers:
 - a. Provide detectable tape on all underground piping:
 - b. Labels shall be color coded and labeled the same as indoors.
- B. Valve tags
1. All valves shall be designated by distinguishing numbers and letters carefully coordinated with a valve chart.
 2. Valve tags shall be color coded 0.032" anodized aluminum tags, with engraved letters similar to Seton S Type 250-BL or approved equal.
 - a. HVAC tags shall be round 2" diameter, similar to Seton 15426.
 - b. Plumbing tags shall be square 2" x 2" similar to Seton 42769.
 - c. Fire Protection tags shall be square 2" x 2" similar to Seton 42769 RED.
 - d. Lettering shall be ¼" high for type service and ½" for valve number. Tag shall indicate service and valve number.
 - e. Each service shall be a different color.
 3. Tag shall be attached to valves with chain similar to Seton No 16 stainless steel jack chain.
- C. Whenever a valve is above a hung ceiling, the valve tag shall be located immediately above the hung ceiling.
- D. Furnish a minimum of two (2) typed valve lists
1. Each framed under glass or Plexiglas. Each chart shall be enclosed in an approved 0.015" thick plastic closure for permanent protection.
 2. Valve numbers shall correspond to those indicated on the Record Drawings and on the printed valve lists.
 3. The printed list shall include the valve number, location and purpose of each valve.
 4. It shall state other necessary information such as the required opening or closing of another valve when one valve is to be opened or closed.

5. Printed framed valve lists shall be displayed in each Mechanical Room or in a location designated by the Owner.
- E. Valve data base.
1. Provide a valve data base for all valves to operate on the building computer.
 2. Every valve shall include:
 - a. Tag Number
 - b. Service (Hot water, Chilled water, Sprinkler, etc.)
 - c. Size
 - d. Operation
 - e. Location
 - f. Manufacture
 - g. Model number
 - h. Submittal reference

2.3 DUCTWORK IDENTIFICATION

- A. All ductwork (supply, return, exhaust, etc.) serving multiple spaces or floors shall be identified with directional flow arrows and unit identification numbers (EF-1, ETC.) on the side of each duct (or bottom if abutting other systems or obstructions).
- B. All flow arrows and labels shall be similar to Seton Name Plate Company vinyl labels or stencil painted.
- C. The kitchen hood exhaust system shall also have identified access doors with numbers of specific doors identified on the Record As-Built Drawings.
- D. All duct access doors.

2.4 EQUIPMENT NAMEPLATES

- A. Equipment nameplates shall be 3" x 6" long, 0.02" aluminum with a black enamel background with engraved natural aluminum letters similar to Seton Style 2065-20. Nameplate shall have pressure sensitive taped backing.
- B. The nameplate shall contain the unit or equipment designation ("AHU" for air handling unit, "HP" for heat pump, "P" for circulating pump, etc.), unit number and area or system served.
- C. Nameplates for exterior equipment shall be applied with waterproof adhesive.

NOTE: Coordinate with architect.

2.5 UTILITY ENTRANCE DESIGNATIONS

- A. Provide a brass wall plaque, minimum 0.020" thickness, secured to the exterior wall just above the grade line for all buried service entrances or exits. Samples are:

Water Service Below; Gas Service Below; Sanitary Sewer Below; Storm Sewer Below; Irrigation Water Below; etc.

PART 3 - EXECUTION

3.1 PREPARATION

- A. All surfaces shall be cleaned and insulated (if applicable) prior to installing any identification.
- B. Exterior surfaces of outdoor equipment shall be dry and prepared to accept the specified identification.

3.2 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion. Seal with clear lacquer.
- B. Install valve tags with chain.
- C. Install duct markers in accordance with manufacturer's instructions.
- D. Install plastic pipe markers in accordance with manufacturer's Instructions.
- E. Install plastic tape markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Identify air handling units, pumps, boilers, domestic hot water heaters, fire pumps, heat transfer equipment tanks, water treatment devices, etc. with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Install detector tape on all underground services in accordance with the manufacturers recommendations.
- J. Identify thermostats relating to air handling equipment serving multiple spaces.
- K. Identify valves in main and branch piping with valve tags.
- L. Tag automatic controls, instruments and relays. Key to control schematic.
- M. Identify piping, concealed or exposed, with pipe markers or where buried using plastic tape pipe markers. Use tags on piping $\frac{3}{4}$ inch diameter and smaller. Identify service, flow direction and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

- N. Identify ductwork with plastic nameplates and flow arrows. Identify with air handling unit or fan identification number and area served. Locate identification at air handling unit or fan, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 230593 – TESTING, ADJUSTING AND BALANCING
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Provide all labor, instruments and materials necessary to completely test, adjust and balance all HVAC systems and equipment installed under this contract.
- B. All instruments shall be newly calibrated for this specific project.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. AABC MN-1 – National Standard for Testing and Balancing Heating, Ventilating and Air Conditioning Systems.
 - 2. ASHRAE 111 – Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

1.5 SYSTEM DESCRIPTION

- A. Provide under this contract the services of an independent test and balance firm that specializes in testing and balancing of HVAC systems. The following services shall be provided:
 - 1. Balance Plan Check and Review: Review the design documents prior to commencing balancing. Submit any noted questions or discrepancies in writing to the Architect.

2. On-going job site inspections of equipment, controls and metering devices during construction to verify conformance with design specifications, manufacturer's installation instructions.
3. Air System Balance
4. Control Systems Verification
5. System Performance Verification
6. Opposite Season Test

1.6 SUBMITTALS

- A. See Section 230500 for submittal procedures.
- B. Submit name of testing, adjusting and balancing contractor for approval within 30 days after award of Contract.
- C. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting and balancing of systems and equipment to achieve specified performance.
 1. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing and equipment data required.
 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for inclusion in operating and maintenance manuals.
 3. Provide reports in letter size, 3 ring binder manual, complete with index page and indexing tabs with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets and indicating thermostat locations.
 4. Include detailed procedures, agenda, sample reports forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
 5. Test Reports: Indicate data on AABC MN-1 forms, forms prepared following ASHRAE 111, NEBB forms, or forms containing information indicated in Schedules.
 6. Include the following on the title page of each report.
 - a. Name of Testing, Adjusting and Balancing Agency.
 - b. Address of Testing, Adjusting and Balancing Agency.

- c. Telephone number of Testing, Adjusting and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Architect.
 - g. Project Engineer.
 - h. Project Contractor.
 - i. Report date.
- D. Project Record Documents: Record actual locations of all water systems balancing valves and rough setting.

1.7 DEFINITIONS

- A. AABC: The Associated Air Balance Council is a non-profit association of independent, certified agencies specializing in testing and balancing HVAC systems.
- B. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers.
- C. HVAC: Heating, Ventilating and Air Conditioning.
- D. TAB: Testing, Adjusting and Balancing of HVAC Systems to meet design objectives and obtain optimum system performance.
- E. NEBB: National Environmental Balancing Bureau
- F. TBE: Test and Balance Engineer is an individual certified by AABC as having a degree in Engineering and (3) years of test and balance experience, or (5) years of background in the air conditioning field and (5) years continuous field experience in testing and balancing work. The TBE must also pass the AABC Test and Balance Engineer Certification Examination.

1.8 AGENCY QUALIFICATIONS

- A. Testing and balancing agency shall be a member of AABC or NEBB with a minimum of five (5) years of documented experience.
- B. An AABC certified NEBB certified testing and balancing person shall be responsible for certification of the total work of this section.

- C. All work shall be performed in accordance with AABC National Standards. If these specifications set forth more stringent requirements than the AABC National Standards, the more stringent specifications shall prevail.

1.9 QUALIFICATION SUBMITTALS

- A. Testing and Balancing Agency shall submit a company resume listing personnel and project experience in the field of air and hydronic system balancing.
- B. Testing and balancing agency shall submit an inventory and calibration data of all instruments and devices in possession of the balancing agency to enable the Owner or his representative to evaluate the balancing agency's performance capability.
- C. The testing and balancing agency shall submit to the Owner or the Owner's representative, upon acceptance of the contract, an AABC or NEBB "Quality Assurance Guaranty."
- D. Within (30) days after acceptance of the contract, the testing and balancing agency shall submit to the Design Engineer a working agenda which will include procedures for testing and balancing each type of air and water flow system. The Test and Balance Report format will also be submitted indicating data to be recorded.

1.10 CONTRACT DOCUMENTS

- A. Within (30) days after selection of the test and balance agency, the Mechanical Contractor Construction Manager shall provide the agency with the following:
 - 1. Construction Drawings
 - 2. Equipment Specifications
 - 3. Equipment Submittals
- B. The testing and balancing agency shall be provided the following as issued or received:
 - 1. Change Orders/Current Updated Construction Mechanical Drawings incorporating all revisions
 - 2. Equipment Manufacturer's Submittal Data
 - 3. Mechanical/Air Conditioning Contractor's Shop Drawings
 - 4. Temperature Control Drawings

5. Project Schedule

1.11 NOTIFICATION AND SCHEDULING

- A. A prebalance conference shall be held prior to job start as scheduled by the Owner or Owner's representative. Attendees at the meeting shall include representatives of the test and balance agency, General Contractor, Mechanical Contractor, Control Contractor, Owner and Mechanical Engineer.
- B. The schedule for testing and balancing the HVAC system shall be established by the Owner or Owner's representative, in coordination with the testing and balancing agency on a critical path network.
- C. The testing and balancing agency is responsible for initiating this continuing coordination to determine schedule for final testing and balancing services.
- D. It will be necessary for the testing and balancing agency to perform its services in close coordination with the Mechanical Contractor, with all scheduling and deficiencies reported through the Owner or Owner's representative.
- E. Before testing and balancing commences, the testing and balancing agency shall receive notification, in writing, from the Mechanical Contractor that the system is operational, complete, and ready for balancing.
- F. A completed system exceeds physical installation: the Mechanical Contractor shall certify that all prime movers, fans, etc., are installed in good working order, and that full load performance has been preliminary tested.
- G. The Mechanical Contractor shall certify in writing, that all equipment has been checked, started, adjusted by the manufacturer, and operated for the specified period of time.

1.12 COORDINATION WITH OTHER TRADES

- A. To bring the HVAC system into a state of readiness for testing, adjusting and balancing, the Mechanical Contractor shall perform the following:

PART 2 - PRODUCTS

2.1 GENERAL

- A. The (Owner) (Construction Manager) (General Contractor) (HVAC Contractor) shall procure the services of an independent Balancing and Testing Contractor who specializes in the balancing and testing of heating, ventilating and air conditioning systems to balance and adjust, all moving equipment and air

distribution and exhaust systems and test all water systems and equipment, as herein specified. All work by the Balancing Contractor shall be done under direct supervision of a qualified heating and ventilating Engineer employed by the Balancing Contractor. Balancing Contractor shall submit credentials and be approved prior to any contract award.

- B. Balance and testing shall not begin until all HVAC systems have been completed and are in full working order, as determined by the Architect. Where construction is phased, the Testing and Balancing Contractor shall submit a plan of action which outlines how each phase will be balanced and how, when completed, the entire system will be verified to be tested and balanced. The Balancing Contractor shall coordinate his work with the HVAC and ATC Contractors, shall place all heating, ventilating and air conditioning systems and equipment into full operation, and continue the operation of same during each working day of adjusting and balancing.
- C. The Balancing Contractor shall perform all tests as hereinafter specified, compile the test data, and submit five (5) copies of the complete test data to the (Owner) (Construction Manager) (General Contractor) (HVAC Contractor) for forwarding to the Architect for evaluation and approval.
- D. The (Owner) (Construction Manager) (General Contractor) (HVAC Contractor) shall award the test and balance contract to the approved agency at the beginning of construction of the project to allow the Balancing Contractor to schedule this work in cooperation with the HVAC Contractor, ATC Contractor and other Trades involved and comply with completion data and requirements, as well as provide a list of areas where special requirements for balancing devices (dampers, valves) might occur.
- E. The Balancing Contractor shall provide all testing instruments used for balancing air and water systems. Testing instruments shall have been calibrated within a period of six (6) months prior to balancing. Types, serial numbers and dates of calibration of all instruments shall be listed in the final air and water balance reports herein specified.
- F. The Architect's, Engineer's and Owner's designated representatives shall be notified minimum five (5) days in advance of proceeding with balancing work to allow time for the witnessing of the testing, balancing and adjusting.
- G. The Balancing Contractor shall provide all manpower, instruments, temporary connections and all other materials required to accomplish the balancing and testing as hereinafter specified. In the case of phased construction, the action plan shall include an explanation of all temporary facilities and their effect on the overall system.

- H. The Balancing Contractor shall balance cooling systems in the air conditioning season and heating systems in the heating season. This requirement is mandatory.
- I. In the event it becomes necessary for the Owner to balance the HVAC systems correctly, after the balancing is complete, the cost of this work will be back charged to the Balancing Contractor.

2.2 SCHEMATIC SYSTEM DRAWINGS

A. Piping Systems

1. The Balancing Contractor shall prepare schematic diagrammatic drawings
2. The drawings will be 1-line schematic representation of the systems as they are installed, indicating all major automatic control valves, strainers, pressure reducing valves, etc., as well as all water flow and energy meters.
3. The diagrams shall indicate, in addition to the graphic representation requirements outlined above, all pressure drops (design conditions and actual conditions) of each valve, strainer, meter, etc., as well as all flows at each meter.
4. The use of the Engineer's construction drawing diagrams can be utilized by the Balancing Contractor as the base of the diagrams required. However, the drawings will have to be updated by the Balancing Contractor for field modifications which may have occurred during construction.

B. Ductwork Systems

1. The Balancing Contractor shall prepare schematic diagrammatic drawings for the following:
 - a. All exhaust air systems including specialized exhaust systems
2. The drawings will be 1-line airflow schematics emanating from the air handling equipment, through shafts, to the first major split of duct branches on each floor. The drawings will indicate the air quantities measured at these major branches, pressure drop and any other pertinent information deemed necessary by the Architect.
3. In addition to the duct schematic drawings, the Balancing Contractor shall prepare individual schematic drawings for each air handling unit indicating the pressure drop of each component of the unit, including the discharge plenum and unit duct discharge and shall prepare composite schematic drawing of all "special pressure" rooms or spaces which shall show on one

drawing, the supply, return and/or exhaust systems, flow rates (design and actual) and final offset pressure/CFM.

- C. The intent of the required documentation would be to clearly indicate the balancing and performance of the systems as they are installed. Furthermore, the above-required information will be utilized by the Owner for future renovation and/or alterations of the various systems. Therefore, the drawing content and presentation will be submitted to the Architect for review prior to actual commencement of the work. In the case of phased construction, the schematics shall indicate the limit of each phase and any temporary measures taken to obtain system performance.
- D. The drawings shall be produced on AutoCAD latest, and a disc and one (1) set of reproducible vellums shall be submitted to the Owner through the Architect, for his use. All costs associated with the production of the documents shall be included under the Balancing Contractor's contract.
- E. Test Code Drawings
 - 1. Each report shall contain a single line drawing or drawings of the air distribution system with the fan system, applicable zoning, etc., indicated. Each and every outlet supply and return shall be indicated on this drawing by a number corresponding to the number of the outlet test sheet.

2.3 TEST FORMS USED BY BALANCING ENGINEERS AND TECHNICIANS SHALL BE SET UP TO INCLUDE THE FOLLOWING INFORMATION:

- A. Each sheet shall have the job name and address, the name of the Balancing Contractor, Owner, Architect and Engineer, the instruments used to perform the test, and the name of the test Technician, date and time of test, outside db/wb temperatures.
- B. All forms shall be submitted on a standard 8 1/2" by 11" good quality paper, bound together to form a complete report. All forms shall be submitted in typewritten form; handwritten forms are not acceptable. Cover of first sheet shall list the name of the job and the location of same. Copies of all forms shall be submitted to the Architect for review and acceptance prior to the work beginning.
- C. Diffuser, Grille, Register, Fume Hoods, and All Types of Air Terminal Test Sheets
 - 1. Each sheet shall be arranged in columns and all final sheets shall show the following data:
 - a. Fan system.

- b. Room number or area designation.
- c. Outlet code number which shall correspond to code number.
- d. Size of outlet - manufacturer's listed data.
- e. Type of outlet per manufacturer's model designation.
- f. Manufacturer of outlet.
- g. Manufacturer's effective area for each size.
- h. Schedule FPM and required CFM of each outlet, individually for heating and cooling.
- i. Test resultant FPM and CFM of each outlet, individually for heating and cooling.
- j. Testing, setting and report of CFM settings for each terminal box, including pressure drop at each setting (heating and cooling).
- k. All rooms/spaces with ducted supply and return/exhaust are to have supply, return/exhaust quantities shown on the same sheet. All rooms are to have air quantities for supply, return/exhaust listed per individual room. Supply, return/exhaust readings shall be listed sequentially, with final CFM offset, or room pressure clearly identified.

D. Exhaust and Ventilating Fan Test Sheets

- 1. Each sheet shall contain in two (2) columns, one (1) for specified conditions and one (1) for test conditions obtained. Variable volume systems data is to be submitted for both maximum and minimum air flows.
- 2. All final sheets shall list the following data:
 - a. Exhaust fan system and exhaust fan number.
 - b. Fan manufacturer.
 - c. Fan curve.
 - d. Size and model.
 - e. Motor HP, voltage and phase.
 - f. Changes made or recommended.

- g. Amperage nameplate rating.
- h. Final operating amperage.
- i. Fan RPM.
- j. Total CFM.
- k. Suction static, discharge static, total static.

PART 3 - EXECUTION

3.1 AIR SYSTEM BALANCING AND TESTING PROCEDURES

- A. The Balancing Contractor shall perform the following tests, and balance all systems in accordance with the following requirements after clean filters are installed in all filter banks before tests are performed:
 - 1. Test and adjust blower RPM or blade pitch angle on vane axial fans to achieve design requirements.
 - a. Test and record motor full load ampere.
 - b. Make pitot tube transverse of main supply, return and exhaust air ducts to obtain design CFM at fans.
 - c. Test and report system static pressure, suction and discharge.
 - d. Test and adjust system for design CFM recirculated air.
 - e. Test and adjust system for design CFM outside air.
 - f. Test and record entering and leaving air temperatures (db-wb cooling and db heating).
 - g. Adjust all main supply, return and exhaust air ducts to proper design CFM.
 - h. Adjust all zones and branches to proper design CFM, supply, return and exhaust systems.
 - i. Test and adjust each diffuser, grille, register, and constant volume box to within $\pm 5\%$ of design requirements.
 - j. Test and adjust all special pressure rooms to maintain pressure relationship indicated on the drawings and to the pressures specified

herein. Note that air quantities on the drawing may have to be changed to satisfy the pressure relationship.

- k. Identify and list size, type and manufacturer of diffusers, grilles, registers, and terminal volume boxes. Include information regarding coils where applicable.
- l. Measure air quantities in main and branch ducts by traversing entire cross sectional area of duct with pitot tube. Ducts having velocities of 1000 feet per minute or more shall be measured with inclined manometers (draft gauge) or magnehelic gauges; ducts having velocities of less than 1000 per feet per minute shall be measured with micromanometers, hook gauges, or similar low pressure instruments. Openings in ducts for pitot tube insertion shall be sealed with snap-in plugs and covered with duct tape after air balance is complete. Diffuser, grille and register air quantities shall be determined by direct reading velocity meters in accordance with the manufacturer's recommendations.
- m. Identify, adjust, balance and measure air quantities in all types of hoods or exhaust "trunks", where applicable. Identify systems by fan designation and room name.
- n. Obtain design air quantities in main ducts by adjusting fans. Branch duct air quantities shall be adjusted by volume dampers. Dampers shall be permanently marked after air balance is complete to enable them to be restored to their correct position if disturbed at any time.
- o. As part of this Contract, the Balancing Contractor shall change the pulleys, belts, and fixed sheaves to provide for permanent sheaves, pulleys and belts, based on the final balancing, in order to ensure proper air delivery of the various systems.

- p. The Balancing Contractor shall also make all necessary adjustments to vane axial fan blade pitch angle to achieve required airflow.
- q. In cooperation with the ATC Contractor, determine the proper setpoint for all automatically operated dampers, air valves, static pressure sensors, inlet vane actuators, or other variable or controllable devices requiring coordination between Balancing Contractor and ATC Contractor. The Balancing Contractor shall determine the lowest system static setpoint possible that will deliver the proper air quantities to all outlets at the maximum cooling condition, and will adjust the fan system to operate at its most economical setting to achieve this static setpoint. Fans will be adjusted to the most economical setting by adjusting the fan speed (or blade pitch angle) with any variable volume devices in their maximum or wide-open position. Final static pressure setpoints are to be recorded in the test and balance report and listed for each unit.
- r. Any dampers, safing of baffles required for final balancing, as determined by the Balancing Contractor the Architect, will be provided by the (HVAC Contractor) (Sheet Metal Contractor) to ensure proper performance, at no extra cost to the Owner.

3.2 INSTALLED ELEMENT TEST PROCEDURES

- A. Element identification (location or number designation).
- B. Required temperature drop corrected for actual entering air and water conditions.
- C. Element adjusted until the required drop is obtained.

3.3 CONTROL SYSTEMS VERIFICATION

- A. Verify all control devices are properly connected.
- B. Verify all dampers, valves and other controlled devices are operated by the intended controller.
- C. Verify all dampers and valves are in the position indicated by the controller (open, closed, modulating).
- D. Verify the integrity of valves and dampers in terms of tightness of close off and full open positions.
- E. Check all valves are properly installed in the piping system in relation to direction of flow and location.
- F. Check calibration of all controllers.

- G. Verify the proper application of all normally open and normally closed valves.
- H. Check the location of all thermostats and humidstats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
- I. Check the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. Control Contractor will relocate as deemed necessary by the testing and balancing agency.
- J. Check the sequence of operation that any control mode is in accordance with approved shop drawings. Verify that only minimum simultaneous heating and cooling occurs. Observe that the control valves at the boiler/heat pump loop are properly sequenced.
- K. Verify all controller setpoints meet the design intent.
- L. Check all dampers for free travel.
- M. Verify the operation of all interlock systems.
- N. Perform all systems verification to ensure the safety of the system and its components.

3.4 SYSTEM PERFORMANCE VERIFICATION

- A. At the time of final inspection, the test and balance agency shall recheck, in the presence of the Owner's representative, specific and random selections of data, air quantities, and air motion recorded in the Certified Report.
- B. Points and areas for recheck shall be selected by the Owner's representative.
- C. Measurement and test procedures shall be the same as approved for work forming basis of Certified Report.
- D. Selections for recheck, specific plus random, will not normally exceed 25% of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.
- E. If random tests elicit a measured flow deviation of 10% or more from that recorded in the Certified Report listings, by 10% or more of the selected recheck stations, the report is rejected, all systems shall be readjusted and tested, new data recorded, new Certified Report submitted, and new inspection tests made, all at no additional cost to Owner.
- F. Following system verification of the Certified Report by the Owner's representative, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the testing and balancing agency so that

adjustment can be restored if disturbed at any time. Devices shall not be marked until after system verification.

3.5 OPPOSITE SEASON TEST

- A. The testing and balancing agency shall perform an inspection of the HVAC system during the opposite season from that in which the initial adjustments were made. The testing and balancing agency shall make any necessary modifications to the initial adjustments to produce optimum system operation.

3.6 RECORD AND REPORT DATA

- A. The test and balance report shall be complete with logs, data and records as required herein. All logs, data and records shall be typed on white bond paper and bound. The report shall be certified accurate and complete by the testing and balancing agency's certified balancing engineer.
- B. Six (6) copies of the test and balance report are required and shall be submitted to the Owner or the Owner's representative.
- C. The report shall contain the following general data in a format selected by the testing and balancing agency.
 - 1. Project number.
 - 2. Contract number.
 - 3. Project title.
 - 4. Project location.
 - 5. Project Architect.
 - 6. Project Mechanical Engineer.
 - 7. Test and Balance Agency.
 - 8. Balancing Engineer.
 - 9. General Contractor.
 - 10. Mechanical Contractor.
 - 11. Date tests were performed.
 - 12. Certification.

D. The test and balance report shall be recorded on report forms conforming to the recommended forms in AABC National Standards. At a minimum, the report shall include:

1. Preface: A general discussion of the system, any abnormalities and problems encountered.
2. Instrumentation List: The list of instruments including type, model, manufacturer, serial number, and calibration dates.
3. System Identification: In each report the supply, return and exhaust openings and traverse points shall be numbered and/or lettered to correspond to the numbers and letters used on the report data sheets.
4. Air Handling Equipment(Heat Pumps, Makeup Air, Roof Top Units, etc.)
 - a. Manufacturer, model number, and serial number.
 - b. All design and manufacturer related data.
 - c. Total actual CFM by traverse if practical; if not practical, the sum of the outlets may be used, or a combination of each of these procedures. For specific systems, such as ones with diversity, see the AABC National Standards.
 - d. Suction and discharge static pressure of each fan, as applicable.
 - e. Outside air and return air total CFM.
 - f. Actual operating current, voltage, and brake horsepower of each fan motor.
 - g. Final RPM of each fan.
 - h. Fan and motor sheave manufacturer, model, size, number of grooves, and center distance.
 - i. Belt size and quantity.
 - j. Static pressure controls final operating setpoints.

END OF SECTION 230593

SECTION 230598 – MECHANICAL VIBRATION CONTROLS AND SEISMIC RESTRAINTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all necessary vibration isolation materials to eliminate excessive noise and vibration from all building HVAC systems.
- B. Seismic restraints for all systems shall be installed in accordance with the latest state/structural codes:
- C. All trapeze supported Items weighing 10 Lbs per foot or greater shall be braced. This weight shall include all pipes and conduits filled with water.
- D. Secure all permits and local/state approval for the installation of all components included under this Section.
- E. The work in this Section shall include the following:
 - 1. Vibration isolation elements for equipment.
 - 2. Equipment isolation bases.
 - 3. Piping flexible connectors.
 - 4. Seismic restraints for isolated equipment.
 - 5. Seismic restraints for non-isolated equipment.
 - 6. Seismic restraints for ductwork
 - 7. Seismic restraints for piping
 - 8. Certification of seismic restraint designs and installation supervision.
 - 9. Certification of seismic attachment of housekeeping pads.
- F. Coordinate closely with Hangers and Supports, Pipe Expansion and Structural documents.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.
- B. Refer to Section 230529 – Hangers and Supports.

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. NEBB– Procedural Standards for Measuring Sound and Vibration; National Environmental Balancing Bureau.
 - 2. NEBB– Sound and Vibration in Environmental Systems; National Environmental Balancing Bureau.
 - 3. SMACNA – Guidelines for Seismic Restraint of Mechanical Systems.
 - 4. ASHRAE Guidelines – HVAC Applications; Chapter– Sound and Vibration Control, Chapter – Seismic Restraint Design, Latest Edition.
 - 5. ASCE Standard 7 Minimum Design Loads for Buildings and Other Structures

1.5 SUBMITTALS

- A. See Section 230500 and General Conditions for additional requirements.
- B. The Vibration Isolation Submittal shall include descriptive data for all products and materials including the following:
 - 1. Product Descriptions
 - a. A complete description of products to be supplied, including product data, dimensions, specifications and installation instructions.
 - b. An itemized list of isolated and non-isolated equipment. Detailed schedule and selection data for each vibration isolator and seismic restraint supporting equipment, including:
 - 1) Equipment identification mark
 - 2) Isolator type
 - 3) Actual load
 - 4) Static deflection expected under actual load
 - 5) Specified minimum static deflection
 - 6) Additional deflection-to-solid under load
 - 7) Ratio of spring height under load to spring diameter
 - 8) Base type
 - 9) Seismic restraint type

- c. Steel rails, steel base frames, and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method, and location of equipment attachment bolts.
 - 2. Show equipment base construction for all equipment, including dimensions, structural member sizes and support point locations.
 - 3. Indicate isolation devices selected with complete dimensional and deflection data.
 - 4. Show all methods of suspension and support for ceiling hung equipment.
 - 5. Detail methods of isolation for ducts and pipes piercing walls and slabs.
 - 6. Provide specific details of seismic restraints and anchors, including number, size and locations for each piece of equipment.
 - 7. Provide special details necessary to convey complete understanding of the work to be performed.
- C. Seismic Analysis and Certification submittals shall include the following:
 - 1. Seismic restraint calculations must be provided for all connections of equipment to the structure.
 - 2. Calculations to support seismic restraint designs shall be stamped by a registered Professional Engineer.
 - 3. Analysis must indicate calculated dead loads, derived loads, and materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and weld length.
 - 4. A seismic design liability insurance certificate must accompany all submittals.
 - 5. Coordinate all hangers and supports.
 - 6. Provide Approved Agencies Certificate of Compliance meeting Seismic Category D for all components. Tests shall include anchorage, structural and on line capability from analytical or shaker test method.
 - a. Where the requirements of this specification cannot be met by any vendor, the contractor will submit a written summary indicating the lack of resources.
- D. Submission of samples may be requested for each type of vibration isolation and seismic device. After approval, samples will be returned for installation at the job if requested. All costs associated with submission of samples shall be borne by the Contractor.
- E. Provide seismic certifications for all equipment including, but not limited to:
 - 1. Fans

1.6 QUALITY ASSURANCE

- A. All vibration isolators shall have calibration markings or some method to determine the actual deflection under the imposed load after installation and adjustment.
- B. All isolators shall operate within the linear portion of their load versus deflection curves. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of at least 50% above the design deflection.
- C. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than $\pm 10\%$, and shall be non-resonant with equipment forcing frequencies or support structure natural frequencies.
- D. All neoprene components shall have a shore hardness of 30 to 50 $\pm 5\%$, after minimum aging of (20) days or equal oven aging.
- E. Substitution of internally isolated and restrained equipment in lieu of the isolation and restraints specified in this Section is acceptable provided all conditions of this Section are met. The equipment manufacturer shall provide a letter of guarantee stating that the specified noise and vibration levels will be obtained and that the seismic restraints shall be in compliance with these specifications. All costs for converting to the specified external vibration isolation and/or restraints shall be borne by the equipment manufacturer/installing contractor should submissions or installations be found to be unacceptable pursuant to the intent of this specifications.
- F. Should any rotating equipment cause excessive noise or vibration, the Contractor shall be responsible for rebalancing, realignment, or other remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.
- G. Upon completion of the work, the Architect or Architect's representative shall inspect the installation and shall inform the Installing Contractor of any further work that must be completed. Make all adjustments as directed by the Architect that result from the final inspection. This work shall be done before vibration isolation systems are accepted.
- H. Manufacturer Responsibility
 - 1. Manufacturer of vibration and seismic control equipment shall have the following responsibilities:
 - a. Determine vibration isolation and seismic restraint sizes and locations.
 - b. Provide equipment vibration isolation and seismic restraints as scheduled or specified.
 - c. Guarantee specified isolation system deflections.
 - d. Provide installation instructions, drawings and field supervision to ensure proper installation and performance of systems.

- e. Provide certification by a licensed engineer that all mounts and restraints meet the project requirements for seismic loading.
- 2. Substitution of internally isolated mechanical equipment in lieu of the specified isolation of this Section must be approved for individual equipment units and is acceptable only if above acceleration loads are certified in writing by the equipment manufacturer and stamped and sealed by a licensed Civil or Structural Engineer.
- 3. Licensed Engineers shall be licensed in the project state.

I. Contractor Responsibilities

- 1. The Contractor performing the work on equipment in the section shall have the following responsibilities.
 - a. Identify the components that are part of the Quality Assurance Plan.
 - 1) All flammable, combustible and highly toxic piping and their associated mechanical systems.
 - 2) All ductwork containing hazardous materials.
 - 3) All equipment using combustible or toxic energy sources.
 - b. Identify all Special inspection and Testing.
 - c. List control procedures within the contractor's organization including methods and frequency of reporting and their distribution.
 - d. List personnel and their qualifications exercising control over the seismic aspects of the project.
- 2. Purchased and/or fabricated equipment must be designed to safely accept external forces of 1.8 g load in any direction for all rigidly supported equipment, piping and ductwork without failure and permanent displacement of the equipment. Resiliently supported equipment, piping and ductwork and Life safety equipment such as fire pumps, smoke exhaust fans, emergency generators and other life safety designated equipment must be capable of accepting external forces of up to 3.6 g in any direction without permanent displacement or failure of the equipment.

1.7 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping system and ASTM F708 for design and installation of pipe hangers.
- B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.

- C. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.8 DELIVERY, STORAGE AND HANDLING

- A. All vibration control and SEISMIC restraint equipment shall be delivered in containers and shall be kept in a dry and protected area.
- B. All exposed hangers, supports, etc. shall be given 2 coats of rust resistant paint of a color selected by the Architect prior to installation.

PART 2 – PRODUCTS

2.1 ISOLATORS AND RESTRAINTS – GENERAL

- A. Acceptable Manufacturers subject to compliance to specifications.
 - 1. Mason Industries (MI)
 - 2. Amber/Booth (AB)
 - 3. Kinetics Noise Control (KNC)
 - 4. Vibration Eliminator Co. (VEC)
 - 5. Vibration Mountings & Controls (VMC)
- B. The Mechanical Contractor shall provide necessary vibration isolation materials to eliminate excessive noise and vibration from being transmitted from HVAC equipment to the occupied areas of the structure, and to serve as the basis for seismic restraint design for the entire HVAC system within the building. This includes all non-structural components such as, but not limited to, air handlers, fans, pumps, tanks, ductwork, piping, etc. (hereinafter called equipment).
- C. Seismic restraints and vibration isolation types shall be capable of accepting, without failure, seismic forces determined in accordance with:
 - 1. International Building Code
 - 2. State/Country Codes
 - 3. Local codes enforced at the specified project location.
- D. Isolators and supports shall maintain the equipment in a captive position and not short circuit isolation during normal operating conditions. Isolators shall have provisions for bolting and/or welding to the structure.
- E. All metal parts of vibration isolation units installed out-of-doors shall be hot dip galvanized, cadmium plated, or neoprene or PVC coated after fabrication. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard #14.

- F. All base supported isolators shall have base plates with bolt holes for fastening the isolators to the support members.
- G. Isolator types are scheduled to establish minimum standards. At the Contractor's option, laborsaving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages. Accessories must not degrade the vibration isolation system.
- H. Static deflection of isolators shall be as scheduled in this Section and as shown on the drawings. All static deflections stated are the minimum acceptable deflection under actual load. Isolators shall be selected for no less than 50% reserve deflection beyond actual operating conditions.
- I. Attachment plates to be cast into housekeeping pads, concrete inserts, beam clamps, etc. that may be required for seismic compliance shall be provided by this Section.
- J. Coordinate the size, location and special requirements of vibration isolation equipment and systems with other Trades. Coordinate plan dimensions with size of housekeeping pads.

2.2 SEISMIC RESTRAINT TYPES

- A. Type I
 - 1. Type I shall comply with general characteristics of spring isolator Type A with snubbing restraint in all directions capable of supporting equipment at fixed elevations during installation. Cast or aluminum housings, except ductile iron are not acceptable.
 - 2. Type I seismic restraint shall be similar to Mason Industries Type SLRS.
- B. Type II
 - 1. Each corner or side of equipment base shall incorporate a seismic restraint snubber having a minimum of 5/8" thick resilient pad limit stop. Seismic snubbers shall be in accordance with manufacturer's recommendations.
 - 2. Type II seismic restraints shall be similar to Mason Industries Type Z-1011 or Z-1225.
- C. Type III
 - 1. Type III shall be multiple metal cable or strut type with approved fastening devices to equipment and structure. System to be field bolted to deck or to overhead structural members using 2-sided beam clamps or appropriately designed inserts for concrete. All parts of the system including cables, excluding fasteners, are to be of a single supplier to ensure seismic compliance.
- D. Type IV

1. Type IV shall have double deflection neoprene isolator (minimum 0.3") encased in ductile iron or steel casing.
 2. Type IV seismic restraints shall be similar to Mason Industries Type BR, RBA or RCA.
- E. Type V
1. Non-isolated equipment shall be field bolted or welded (powder shots not acceptable) to the structure as required to meet seismic forces. Bolt diameter, imbedment data and/or weld length must be shown in certified calculations.

2.3 VIBRATION ISOLATOR TYPES

- A. Type D
1. Double deflection neoprene isolator (minimum 0.3") encased in ductile iron or steel casing.
 2. Similar to Mason Industries Type BR, RBA or RCA.
- B. Type I (Thrust Restraints)
1. A spring element similar to Type A isolator shall be combined with steel angles, back-up plates, threaded rod, washers and nuts to produce a pair of devices capable of limiting movement of air handling equipment to 1/4".
 2. Restraint shall be easily converted in the field from a compression type to tension type.
 3. Unit shall be factory pre-compressed.
 4. Thrust restraints shall be installed on all cabinet fan heads, axial or centrifugal fans and other equipment as scheduled.
 5. Type I restraint shall be similar to Mason Industries Type WB.
- C. Type J (Steel Rails)
1. Steel members of sufficient strength to prevent equipment flexure during operation.
 2. Height saving brackets as required to reduce operating height.
 3. Type J isolator shall be similar to Mason Industries Type ICS.
- D. Type K (Pipe Anchors and Guides)
1. Acoustical pipe anchor or guide, consisting of a telescopic arrangement of (2) sizes of steel tubing separated by a minimum 1/2" thickness of Type H pad.
 2. Vertical restraints shall be provided by a similar material arranged to prevent vertical travel in either direction (anchors only).

3. Allowable loads on isolation materials shall not exceed 500 psi, and the design shall be balanced for equal resistance in any direction.
4. Anchors and guides must be bolted or welded to meet seismic criteria.
5. Type K anchor shall be similar to Mason Industries Type ADA.

2.4 VIBRATION ISOLATION SCHEDULE

Equipment	HP	Mtn g	On Grade ****				Above Grade			
			Isol	Defl	Base	Restr	Isol	Defl	Base	Restr
Air Conditioning Units (DX)		Flr	A	1.0	---	II	A	1.0	B-1	I,II
		Clg	---	---	---	---	F	1.0	---	III
Centrifugal Fans		Flr	A	1.0	B-1	II	A**	See	B-2	I,II
		Clg	---	---	***	---	F	Guide	***	III
Unit/Cab. Heaters		Clg	---	---	--	--	E	.30	---	III

- * Used on vertically arranged units. Rails shall be 1.5 times the unit height.
- ** Substitute Type B isolator for Outdoor installations.
- *** Substitute Type B-2 base for floor mounted Class 2 and 3 fans.
- **** "On Grade" shall mean slab on grade only.
- ***** Fans in all units shall be isolated in accordance with chart.

Notes:

1. "Isol", "Base" and "Restr" columns indicate letter type as appears in the specs.
2. "Mtng" refers to method of support of equipment from the structure.
3. "See Guide" indicates isolator deflection selection to be taken from Deflection Guide below.

Deflection Guide	
RPM	MW Deflection
<400	3.5"
<600	2.5"
>600	1.5"

PART 3 – EXECUTION

3.1 GENERAL

- A. Isolation and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and submittal data. Vibration isolators shall not cause any change of position of equipment resulting in stress on equipment connections.
- B. Design Criteria
1. All mechanical equipment such as pumps, heat pumps, fans, etc. shall be isolated from the building structure by means of noise and vibration isolators.
 2. Piping and/or ductwork penetrations through floors and walls shall not be rigidly connected to the building structure. Provide sleeves with clearances around the outside, as recommended by the vibration materials manufacturer. All such penetrations shall be smokeproofed and firestopped in an approved manner as hereinbefore specified.
 3. Generally, isolation facilities shall be designed to limit equipment room floor or roof loading to a maximum of 50 lbs./sq.ft. and vibration isolators shall be carefully and specifically selected for each piece of equipment.
 4. Flexible duct connections at fans and air handling units shall have a minimum clear gap of 3" between metal collars. Flexible connectors exposed to the weather shall be weatherproofed by the Mechanical Contractor. Refer to the Sheet Metal Section of this specification for requirements of flexible duct connections.
 5. Piping found to have water hammer or other objectionable vibration or noise which cannot be eliminated by proper grading or other natural means shall be braced, trapped, hung with vibration isolation hangers, equipped with air chambers or mechanical shock absorbers, flexible pipe connectors, or otherwise silenced using means as approved by the Architect.

6. Motor driven equipment which is to be isolated shall have motor mounted on the isolated equipment or shall have motor, equipment and drive mounted on a common base.
7. The Contractor shall not install any equipment, piping or conduit which makes rigid contact with the "building" unless permitted in this Specification. Building includes, but is not limited to, slabs, beams, columns, studs and walls.
8. Isolation mounting deflection shall be (minimum) as specified or scheduled on drawings.
9. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following work, such as plastering or electrical, to avoid any contact which would reduce the vibration isolation.
10. Bring to the Architect's attention, prior to installation, any conflicts with other trades that will result in unavoidable rigid contact with equipment or piping as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
11. Bring to the Architect's attention any discrepancies between the specifications and field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the contractor's expense.
12. Obtain inspection and approval of any installation to be covered or enclosed, prior to such closure.
13. Correct, at no additional cost, all installations which are deemed defective in workmanship or materials.

3.2 EQUIPMENT ISOLATION INSTALLATION

- A. Equipment shall be isolated and restrained as per the vibration isolation schedule at the end of this Section.
- B. Place floor mounted equipment on 4" high concrete housekeeping pads (unless detailed otherwise) properly doweled or expansion shielded to the deck to meet acceleration criteria. Anchor isolators and/or bases to housekeeping pads. Housekeeping pad concrete work shall be by Division 3. Housekeeping pads shall be sized to have a minimum of 6" of clearance all around the equipment or 12 bolt diameters, whichever is greater.
- C. Additional Requirements
 1. The minimum operating clearance under inertia bases shall be 2".
 2. The minimum operating clearance under other bases shall be 1".

3. All bases shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment, isolators and restraints.
4. The isolators shall be installed without raising the equipment.
5. After the entire installation is complete, and under full operational load, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. The blocks shall be barely free and shall be removed. Remove all debris from beneath the equipment and verify that there are not short circuits of the isolation. The equipment shall be free in all directions.
6. Install equipment with flexibility in wiring.

3.3 PIPING AND DUCTWORK ISOLATION INSTALLATION

- A. Isolate piping and ductwork outside shafts connected to rotating or reciprocating equipment and pressure reducing stations as follows:
 1. All water piping in mechanical rooms.
 2. Water piping within 50'-0" or 100 pipe diameters (whichever is greater) from connected isolated equipment.
- B. The isolators shall be installed with the hanger box hung as closely as possible (without direct contact) to the structure.
- C. The isolators shall be suspended from substantial structural members sized for a maximum deflection of $L/360$ at mid span, not from slab diaphragm, unless specifically permitted by the structural engineer.
- D. Hanger rods shall not short circuit the hanger box.
- E. Horizontal suspended water piping 1 1/4" to 2" shall be suspended by Type E isolators with a minimum 3/8" deflection. Water pipe larger than 2" shall be supported by Type F isolators with a minimum 0.75" deflection or same deflection as equipment for the first (3) locations nearest equipment, whichever is greater.
 1. Type L isolators may be substituted for the above.
 2. Horizontal floor and roof supported pipe shall be the same as above except use isolators Type D and Type A, respectively.
- F. Ductwork shall be supported by Type C isolators with a minimum 0.75" deflection.
- G. Vertical riser pipe supports, where required, under 2" diameter shall utilize Type H isolation.
- H. Vertical riser guides, where required, shall avoid direct contact of piping with the building.
- I. Pipe anchors or guides, where required, shall utilize Type K isolators.

- J. Riser sway supports, where required, shall utilize (2) neoprene elements (Type G or H) to accommodate tension and compression forces.
- K. Install Type FC-1 (FC-4 for refrigerant piping) flexible connectors at all connections of pipe to isolated equipment such as pumps, as shown on the drawings.
- L. Install FC-2, FC-3 or FC-4 type connectors only at locations which exceed temperature or service (such as gas, fuel oil, or refrigerant) limitations of FC-1.
- M. Emergency generator exhaust shall be provided with Type R isolators with a minimum deflection of 1" (larger deflections may be required). These isolators shall be closely coordinated with expansion and stress calculations and seismic restraints and movements.

3.4 SEISMIC RESTRAINTS INSTALLATION

- A. All floor mounted equipment, whether isolated or not, shall be bolted or welded to the structure to allow for required acceleration. Bolt points, diameter of inserts, imbedment depth and weld length as shown on approved submittal drawings shall be followed in all respects.
- B. All suspended equipment shall be 2-point or 4-point independently braced with Type III restraints, installed taut for non-isolated equipment, such as piping or ductwork and slack with 1/2" cable deflection for isolated equipment. Note: Stiffeners for support rods may be required, certifications shall clearly delineate when such stiffening is required or not.
 - 1. Piping Bracing: Schedule 10 thru 40 welded, screwed, flanged or grooved; 40'-0" maximum transversely, 80'-0" maximum longitudinally, and within 4'-0" each change of direction. No- hub piping shall be at 10'-0" intervals or 40'-0" if 1.0 g couplings are used.
 - 2. Ductwork Bracing: 30'-0" maximum, transversely, 60'-0" maximum longitudinally, and within 4'-0" of each change of direction.
- C. Seismic restraints are not required:
 - 1. Only when explicitly permitted by the code. These permitted exceptions shall be detailed clearly on the first page of the seismic submittal.
- D. Seismic restraints are not required on the following (there are no exceptions for piping containing flammable or hazardous material or connected to life/safety equipment):
 - 1. Piping in mechanical equipment rooms less than 1 1/4".
 - 2. Other piping less than 2 1/2".
 - 3. All rectangular ducts less than 6 sq.ft. in cross sectional areas.
 - 4. All round ducts less than 28" diameter.

5. All pipe suspended by individual hangers 12" in length or less from the top of the pipe support to the bottom of the support for the hanger.
 6. All top supported ducts suspended by hangers 12" or less in length from the top of the duct to the bottom of the support for the hanger.
- E. For overhead supported equipment, overstress of the building structure must not occur. Bracing may occur from:
1. Upper flanges of structural beams.
 2. Upper truss chords in bar joists.
 3. Cast-in-place inserts or drilled and shielded inserts in concrete structures.
- F. Chimneys and stacks passing through floors are to be bolted at each floor level or secured above and below each floor with riser clamps or approved vibration isolation systems with seismic restraints.
- G. Chimneys and stacks running horizontally to be braced every 30 ft (9 m) with Type III restraining system.
- H. Inspection
1. On completion of installation of all vibration isolation and seismic restraint devices herein specified, the local representative of the isolation materials manufacturer shall inspect the completed system and report in writing any installation errors, improperly selected isolation or restraint devices, or other faults that could affect the performance of the system. Contractor shall submit a report to the Architect, including the manufacturer's representative's final report, indicating all isolation reported as properly installed or requiring correction, and include a report by the Contractor on steps taken to properly complete the isolation work.
 2. Provide all special inspections in accordance with IBC and as specified herein.
 - a. Continuous inspection: The full-time observation of work by an approved special inspector pursuant to IBC. The following pieces of equipment require these inspections:
 - 1) All equipment using combustible or toxic energy sources.
 - 2) All electric motors and motor control centers.
 - 3) Reciprocating and rotating type machinery.
 - 4) Pipe.
 - 5) Tanks, heat exchangers & pressure vessels.

- 6) Ductwork.
- b. Periodic inspection: Provide intermittent observation of work by an approved special inspector of the following pieces of equipment in compliance with IBC.
 - 1) All smoke control systems during construction & prior to concealment for leakage testing.
 - 2) Isolator units for seismic isolation system.
 - 3) All flammable, combustible and highly toxic piping and their associated mechanical systems.
 - 4) All ductwork containing hazardous materials.
- c. After all inspections a written report shall be provided.

3.5 INSTALLATION INSTRUCTIONS

- A. Adjust all base and piping isolators as required to prevent stress transfer to equipment.
- B. Set steel bases for 1" clearance between housekeeping pad and base. Set concrete inertia bases for 2" clearance. Adjust equipment level.
- C. Position equipment, structural base and concrete base on blocks or wedges at proper operating height.
- D. Provide all equipment and provide operating load conditions before transferring base isolation loads to springs and removing wedges.
- E. Install inertia bases of type and thickness, with isolators of type and static deflection indicated.
- F. Provide isolators as specified and install in accordance with the manufacturers recommendations. Seismic restraints shall not be installed until isolators are adjusted and equipment height is finalized.
- G. Provide forms for 4" high housekeeping pads under all floor mounted equipment, including those with inertia blocks. Provide necessary reinforcing.
- H. Install equipment with flexibility in wiring connection.
- I. Verify all installed isolators and mounting system permit equipment motion in all directions.
- J. Adjust or provide additional resilient restraints to flexibly limit lateral motion to 1/4" during start-up of equipment.
- K. Before start-up, clean out all foreign matter between bases and equipment to prevent short circuit.
- L. Install flexible pipe connectors on pipe connected to equipment supported by vibration isolation. Hook up piping to equipment and mains with spool pieces. After completion of pressure testing but prior to start-up, remove spool pieces and

install flexible pipe connectors. Identify spool pieces as to equipment served and either entering or leaving.

- M. Provide seismic displacement joints for all piping, ductwork and conduits crossing building expansion joints or building seismic joints.

3.6 CERTIFICATION

- A. Upon completion of installation of all vibration isolation devices and seismic restraints, the Mechanical Contractor shall hire an independent Seismic Professional Engineer to visit the site, inspect the completed project and certify in writing to the Architect that all systems are installed properly, or require correction.

END OF SECTION 230598

SECTION 230713 – DUCT INSULATION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and other Division 1 Specification Section, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all duct insulation, vapor barriers, jackets, finishes, adhesives, cements and accessories to make a complete and insulated system of all ductwork, fittings, joints, offsets and accessories specified herein.
- B. All insulation system materials shall conform to the maximum flame spread/smoke developed ratings specified herein.
- C. All kitchen hood exhaust ductwork and accessories shall be insulated with a rated fireproof insulation system with zero clearance allowed. The system shall extend continuously from the hood connections to the fan intake connection.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Steel and Plate.
 - 2. ASTM B 209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and plate (Metric).
 - 3. ASTM C 518 – Standard Test method for Steady-State Heat Flux Measurements and Thermal Insulating and Finishing Cement.
 - 4. ASTM C 553 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - 5. ASTM C 612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 6. ASTM C 921 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - 7. ASTM C 1071 – Standard Specification for Thermal and Acoustical Insulation (Glass, Fiber, Duct Lining Material).

8. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
9. ASTM E 96 – Standard Test Methods for Water Vapor Transmission of Materials.
10. ASTM E 162 – Standard Test Method for Surface flammability of Materials Using a Radiant Heat Energy Source.
11. ASTM G 21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
12. NFPA 96 – Ventilation Control and Fire Protection of Commercial Cooking Operations.
13. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.
14. SMACNA (DCS) – HVAC Duct Construction Standards – Metal and Flexible.
15. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.
16. ANSI/ASHRAE 90.1 - Energy Conservation in New Building Design.

1.5 SUBMITTALS

- A. See Section 230500 and General Conditions for additional requirements.
- B. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- C. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
- D. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- E. Manufacturer’s Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.6 QUALITY ASSURANCE

- A. All insulation materials, finishes, coatings, cements, tapes, jackets and other insulation accessories shall have minimum composite or individual fire hazard ratings as well as thickness and "C" values conforming to State Building Codes which control building construction materials that may be used on this project. Where specification requirements exceed the Code requirements, the specification shall govern.
- B. Insulation for the various duct systems and associated equipment shall be composed of materials which are non-combustible and/or provide a fire resistive system of insulation which complies with the applicable Code having jurisdiction. Generally, it is required that fire hazard ratings shall not exceed the following, except as noted:

1. Flame Spread Rating: 25 (No Exceptions)
 2. Smoke Developed Rating: 50
- C. All fire hazard ratings shall be as determined by NFPA 255 "Method of Test of Surface Burning Characteristics of Building Materials", ASTM E84 or UL 723.
 - D. All insulation materials herein specified shall be used subject to the manufacturer's temperature limitations and their compatibility with other materials.
 - E. Installation of all insulation work shall be executed by a qualified Insulation Contractor who is thoroughly experienced in this particular type of work and who has adequate facilities and equipment for installation of all insulation work herein specified and who is familiar with the requirements of the Code enforcing Authorities as to fire hazard rating.
 - F. The finished installation shall present a neat and workmanlike appearance with all jackets smooth, with all vapor barriers sealed and intact.
 - G. Where insulation is specified for ductwork, insulate similarly all collars, dampers, edges, joints, etc. connected to system subject to heat loss or gain. Do not cover damper actuators or other maintenance points on equipment unless identified on the insulation with removable access panels or covers.

1.7 REGULATORY REQUIREMENTS

- A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E 84, NFPA 255, or UL 723.
- B. Kitchen hood exhaust ducts shall be insulated with a insulation system complying with NFPA 96.

1.8 DELIVERY, STORAGE AND PROTECTION

- A. Accept materials on site, labeled with manufacturer's identification, product density and thickness.
- B. All materials shall be stored in a dry area free from moisture and debris.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during and after installation for minimum of 24 hours

PART 2 - PRODUCTS

2.1 MANUFACTURERS ACCEPTABLE FOR PRODUCT TYPES INDICATED CONTINGENT UPON PRODUCTS' COMPLIANCE WITH THE SPECIFICATIONS

- A. Insulation:
 1. Manville Corporation.
 2. Owens-Corning Fiberglass Corporation.
 3. Armstrong World Industries, Incorporated.

4. Certainteed Corporation.
 5. Knauf
 6. Morgan Thermal Ceramics
- B. Mastics and adhesives:
1. Childers Products Company.
 2. H. B. Fuller Company, Foster Products Division.
 3. 3M Company Adhesives, Coatings and Sealers.
 4. Armstrong World Industries, Incorporated.
 5. Ruston Plant.
 6. Chicago-Mastic
 7. Insul-Coustic
 8. St. Clair Rubber
 9. Vimasco
 10. Baldwin-Ehret-Hill

2.2 FACED FLEXIBLE FIBER GLASS INSULATION

- A. Faced flexible fiber glass duct insulation shall be equal and equivalent to Owens-Corning Fiberglas Faced Duct Wrap, Series ED 100, FRK-25 having an approximate density of 1.0 lb./cu.ft. and an approximate thermal conductivity of 0.30 at 75° F.
- B. Insulation shall be tightly wrapped on the duct work with all circumferential joints butted and longitudinal joints laped 2 inches and stapled. All joints shall be sealed with approved adhesive. Adhere insulation to ducts with 4 inch wide strips of an approved bonding adhesive, at 18 inches on center. Additionally, secure insulation to bottom of rectangular ducts over 24 inches wide with weld pins or stickclips at no more than 18 inches on center. Alternative means of securing insulation to ducts will be permitted, subject to the manufacturer's recommendations and the Architect's written approval.
- C. Insulation shall be butted with facing overlapping all joints at least 2 inches and sealed with approved fire retardant vapor barrier adhesive. All breaks, punctures and pin penetration in facing, shall be sealed with vapor barrier tape per the manufacturer's published installation instructions.

2.3 INSULATION FACING

- A. Code ASJ: All service jacket composed of high intensity white chemically treated Kraft paper reinforced with fiberglass yarn and mesh and laminated to aluminum foil with a fire retardant adhesive. Longitudinal laps and butt strips shall be a minimum of 3 inches.
- B. Code FSKL: 0.35 mil aluminum foil reinforced with fiberglass yarn reinforcing scrim and laminated to chemically treated fire resistive Kraft paper having a minimum 35 pound per inch width tensile strength when tested in accordance with

ASTM D 828. Water vapor permeability 0.04 perms. Longitudinal laps and butt strips shall be a minimum of 3 inches.

2.4 ADHESIVES

- A. Code ADH-1: Fibrous adhesive, non-flammable, quick setting adhesive for calcium silicate. Similar to Childers CP-97, 98.
- B. Code ADH-2: Fast-drying vinyl base coating and lagging adhesive. Similar to Childers CP-50A HV2.
- C. Code ADH-3: Fast-drying neoprene base adhesive for lap joints of foil-faced facing applied over pipe insulation. Similar to Childers CP-82.
- D. Code ADH-4: Adhesive for use in adhering fiberglass board or blanket insulation to pipe and equipment. 3M Company Insulation Adhesive No. 35 or 38 non-flammable adhesive.

2.5 CAULKING COMPONENTS

- A. Code CC-1: For use with foam glass and/or joint sealant applications. Flexible elastomeric vapor barrier sealant. Similar to Childers CP-76.

2.6 MASTICS

- A. Code MAS-1: Vapor barrier mastic made with an elastomeric resin. For indoor use. Similar to Childers CP-30.
- B. Code MAS-2: A non-water vapor barrier asphaltic emulsion coating, breathing type, for above ground installations. Similar to Childers CP-10.
- C. Code MAS-3: Vapor barrier mastic made with an elastomeric resin. For outdoor use.

2.7 TIE WIRE

- A. Tie wire for securing insulation in place shall be type 304 stainless steel annealed steel wire of gauge and proper spacing as recommended by the insulation manufacturer. Wire shall be drawn up tightly enough to become embedded in the insulation and the ends of the loop twisted, bent over, and pressed into the insulation so as to leave no ends protruding.

2.8 BANDING

- A. 3/8 inch x 0.02 inch type 304 stainless steel for pipe insulation.
- B. 3/4 inch x 0.02 inch type 304 stainless steel for additional insulation jackets.

2.9 WIRE MESH

- A. Wire mesh shall be one inch by No. 20 BGW hexagonal mesh galvanized.
- B. Expanded metal: Expanded metal shall be 1/2 inch Hi-Rib metal lath of copper bearing steel.

2.10 TAPE

- A. Lead foil tape, where specified, shall be 3M Company Lead Foil Tape No. 422, 4 mil thick, acrylic adhesive, 2 inch wide.
- B. Vinyl plastic tape, silver gray, flame resistant, vapor barrier sealant tape on rigid and flexible insulation material for warm or cold air ducts. Similar to 3M Company Duct Sealing Tape No. 474.
- C. Aluminum foil tape, dead soft aluminum foil, point seal on stick pin, metal patching, moisture barrier, heat reflecting and general sealing on aluminum facing foil. Similar to 3M Company Aluminum Foil Tape No. 425.

2.11 STAPLES

- A. Staples shall be galvanized clad outward clinching insulation staples.

2.12 INSULATING CEMENT

- A. Insulating cement shall be a mineral-fiber (wool) ASTM C 195 base material having essentially the same insulating characteristics as the adjacent insulation. Similar to PABCO High Temperature Insulating Cement. Insulating cement shall be applied in layers to a maximum thickness of 1/2 inch. Each layer shall be allowed to dry thoroughly before subsequent layers are applied.

2.13 FINISHING CEMENT

- A. Finishing cement ASTM C 449 shall be diatomaceous silica thermal insulating materials with a suitable proportion of heat resistant binder, hydraulic setting insulating cement capable of withstanding maximum temperature of 700 degrees Fahrenheit. When mixed with water it shall be a plastic mix suitable for trowel applications and shall present a hard, smooth and durable surface after drying. Similar to PABCO No. 127.
- B. Combination insulating and finishing cement:
 - 1. Similar to Ryder One Coat or equal.
- C. Welding studs:
 - 1. Welding studs shall be capacitor type split pin or TCP tipped insulation pins with speed clips. Similar to Nelson Stud Welding Spec. 28.
- D. Corner angles on insulation of ducts, plenums and equipment in finished areas shall be formed of 28 gauge, 1 inch by 1 inch aluminum adhered to heavy Kraft paper having 2 inch by 2 inch by 2 inch wings to protect external corners under glass cloth jackets.
 - 1. Corner beads shall be 26-gauge galvanized steel with 2 ½ inch wings (exposed ducts on roof).

PART 3 - EXECUTION

3.1 INSTALLATION OF INSULATION

- A. All insulation shall be applied by experienced insulating contractors in accordance with best Trade practice.
- B. Test, inspect and clean all surfaces of ductwork to be insulated before applying insulation.
- C. Take all possible precautions to protect work of other Trades. Provide protective covering as required to accomplish this end. This Trade shall be responsible for returning all equipment and material to its original new condition and appearance where damage occurs due to his neglect.
- D. All ductwork shall have been tested and approved prior to installation of insulation.
- E. All ductwork and plenum or surfaces, where subject to condensation on the outside, shall be insulated including vapor seal finish.
- F. All surfaces to be insulated shall be clean, dry and free from dirt and scale when insulation is being applied. Insulation shall be dry at the time of installation and before and during the process of finished application.
- G. Butt ends will not be allowed. However, where required and approved by Architect, jacket material shall be pasted over exposed ends and banded to give a neat and finished appearance. Exposed fiberglass material will not be permitted.
- H. Surfaces of insulation shall be smooth, even and true to line with jackets drawn tight and smoothly secured. Scrap pieces of insulation shall not be used where a full length section will fit.
- I. The methods of application of insulation, finishes, adhesives, cements, accessories are generally specified under the material headings of these specifications. Where not specifically detailed, it is intended that they are equal or exceed the manufacturer's published recommendations, existing at time of bid openings, subject to the approval of the Architect.
- J. Butt covering neatly to walls, floors, ceiling. Apply band at end and position so band covers gap between surface and insulation where exposed.
- K. Fastenings: Provide where required to securely hold insulation. Apply adhesive and weld pins and/or stick clips on exposed risers to prevent slipping and turning of insulation. .
- L. Thickness of insulation shall not be compromised due to piping interferences, improper installation or any other reason.

PART 4 - SCHEDULES

4.1 DUCTWORK INSULATION SCHEDULE:

Service	Type Insulation and Thickness (Inches)	Facing	Additional Jacket
All Exhaust Air Ductwork	Flexible Fiberglass w/Vapor Barrier 2"	FSKL	

A. HVAC Insulation Schedule Notes

1. Provide vapor barrier on all ductwork insulation.
2. FAR=5 installed equals 2" flexible fiberglass.

END OF SECTION 230713

SECTION 230719 – HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all piping insulation, vapor barriers, jackets, finishes, adhesives, cements and accessories to make a complete insulated system for all piping, valves, fittings, joints, offsets and flanges specified herein.
- B. All insulation system materials shall conform to the maximum flame spread/smoke developed ratings specified herein.
- C. Hard insulation material shall be provided at all hangers.
- D. Insulate the following:
 - 1. All scheduled piping, all valves, fittings, elbows, flanges and accessories.
 - 2. All piping exposed to weather including provision of additional weatherproof jacket.
 - 3. All cold water make-up piping and valves. All drain and overflow piping receiving cold water. Piping to/from expansion/compression tanks.
 - 4. All vents and blow-offs in mechanical rooms and elsewhere within reach of personnel.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Section of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. ASTM A 666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.
 - 2. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Steel and Plate.
 - 3. ASTM B 209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and plate (Metric).

4. ASTM C 177 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.
5. ASTM C 195 – Standard Specification for Mineral Fiber Thermal Insulating Cement.
6. ASTM C 240 – Standard Test Methods of Testing Cellular Glass Insulation Block.
7. ASTM C 449/C 449M – Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
8. ASTM C 518 – Standard Test method for Steady-State Heat Flux Measurements and Thermal Insulating and Finishing Cement.
9. ASTM C 533 – Standard Specification for Calcium Silicate Block and Pipe Terminal Insulation.
10. ASTM C 534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
11. ASTM C 547 – Standard Specification for Mineral Fiber Pipe Insulation.
12. ASTM C 552 – Standard Specification for Cellular Glass Thermal Insulation.
13. ASTM C 578 – Standard Specification for Preformed, Cellular Polystyrene Thermal Insulation.
14. ASTM C 591 – Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
15. ASTM C 610 – Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
16. ASTM C 795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
17. ASTM C 921 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
18. ASTM D 1056 – Standard Specification for Flexible Cellular Materials – Sponge ore Expanded Rubber.
19. ASTM D 1667 – Standard Specification for Flexible Cellular Materials – vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
20. ASTM D 1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
21. ASTM D 2842 – Standard Test Method for Water Absorption of Rigid Cellular Plastics.

22. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
23. ASTM E 96 – Standard Test Methods for Water Vapor Transmission Materials.
24. NFPA 225 – Standard Method of Test of Surface Burning Characteristics of Building Materials.
25. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.
26. ANSI/ASHRAE 90.1 – Energy Conservation in New Buildings.

1.5 SUBMITTALS

- A. See Section 230500 and General Conditions for additional requirements.
- B. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- C. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
- D. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- E. Manufacturer’s Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.
- F. Installation Graphic Details.

1.6 QUALITY ASSURANCE

- A. All insulation materials, finishes, coatings, cements, jackets and other insulation accessories shall have minimum composite or individual fire hazard ratings as well as thickness and "C" values conforming to State Building Codes which control building construction materials that may be used on this project. Where specification requirements exceed the Code requirements, the specification shall govern.
- B. Piping insulation for the various piping systems and associated equipment shall be composed of materials which are non-combustible and/or provide a fire resistive system of insulation which complies with the applicable Code having jurisdiction. Generally, it is required that fire hazard ratings shall not exceed the following, except as noted:
 1. Flame Spread Rating 25 (No Exceptions)
 2. Smoke Developed Rating: 50
- C. All fire hazard ratings shall be as determined by NFPA 255 "Method of Test of Surface Burning Characteristics of Building Materials", ASTM E84 or UL 723.

- D. All insulation materials herein specified shall be used subject to the manufacturer's temperature limitations and their compatibility with other materials.
- E. Installation of all insulation work shall be executed by a qualified Insulation Contractor who is thoroughly experienced in this particular type of work and who has adequate facilities and equipment for installation of all insulation work herein specified and who is familiar with the requirements of the Code enforcing Authorities as to fire hazard rating.
- F. The finished installation shall present a neat and workmanlike appearance with all jackets smooth, with all vapor barriers sealed and intact.
- G. Where insulation is specified for piping, insulate similarly all connections, vents, drains and any piping connected to system subject to heat loss or gain. Do not cover vent petcocks, cleanouts or other maintenance points on equipment unless identified on the insulation with removable access panels or covers.
- H. All chilled water system piping, components and accessories are to be insulated in a manner so as to provide a complete, uninterrupted vapor barrier.

1.7 REGULATORY REQUIREMENTS

- A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E 84, NFPA 255, or UL 723.

1.8 DELIVERY, STORAGE AND PROTECTION

- A. Accept materials on site, labeled with manufacturer's identification, product density and thickness.
- B. All materials shall be stored in a dry area free from moisture and debris.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during and after installation for minimum of 24 hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS ACCEPTABLE FOR PRODUCT TYPES INDICATED CONTINGENT UPON PRODUCTS' COMPLIANCE WITH THE SPECIFICATIONS

- A. Insulation:
 - 1. Manville Corporation.
 - 2. Owens-Corning Fiberglass Corporation.
 - 3. Armstrong World Industries, Incorporated.
 - 4. Certainteed Corporation.
 - 5. Knauf

- B. Mastics and adhesives:
 - 1. Childers Products Company.
 - 2. H. B. Fuller Company, Foster Products Division.
 - 3. 3M Company Adhesives, Coatings and Sealers.
 - 4. Armstrong World Industries, Incorporated.
 - 5. Ruston Plant.
 - 6. Chicago-Mastic
 - 7. Insul-Coustic
 - 8. St. Clair Rubber
 - 9. Vimasco
 - 10. Baldwin-Ehret-Hill
- C. Pipe insulation of hanger and support:
 - 1. Pipe Shields, Inc.
 - 2. Rilco Manufacturing Company.
 - 3. Elcen Metal Products Company.
 - 4. Power Piping Company.
 - 5. NPS Industries.
- D. PVC fitting covers:
 - 1. Manville, Corporation.
 - 2. Ceel-Co.
 - 3. Certainteed, Corp.
 - 4. Cell Co. Plastics

2.2 GENERAL

- A. Adhesives and insulation materials: Composite fire and smoke hazard ratings maximum 25 for flame spread and 50 for smoke developed for pipe insulation. Adhesives to be waterproof when cured.
- B. The installation of thermal insulating materials coverings and coatings containing asbestos fibers is forbidden.
- C. Insulation shall not be chemically reactive to the metal over which it is applied. Insulation installed on steel shall be neutral or slightly alkaline. Insulation installed on aluminum shall be neutral or slightly acidic.

2.3 MATERIALS AND COMPONENTS

- A. Caulking components:

1. Code CC-1: For use with foam glass and/or joint sealant applications. Flexible elastomeric vapor barrier sealant. Similar to Childers CP-76.
- B. Mastics:
1. Code MAS-1: Vapor barrier mastic made with an elastomeric resin. For indoor use. Similar to Childers CP-30.
 2. Code MAS-2: A non-water vapor barrier asphaltic emulsion coating, breathing type, for above ground installations. Similar to Childers CP-10.
 3. Code MAS-3: Vapor barrier mastic made with an elastomeric resin. For outdoor use.
- C. Tie wire:
1. Tie wire for securing insulation in place shall be type 304 stainless steel annealed steel wire of gauge and proper spacing as recommended by the insulation manufacturer. Wire shall be drawn up tightly enough to become embedded in the insulation and the ends of the loop twisted, bent over, and pressed into the insulation so as to leave no ends protruding.
- D. Banding:
1. 3/8 inch x 0.02 inch type 304 stainless steel for pipe insulation.
 2. 3/4 inch x 0.02 inch type 304 stainless steel for additional insulation jackets.
- E. Tape:
1. Lead foil tape shall be 3M Company Lead Foil Tape No. 422, 4 mil thick, acrylic adhesive, 2 inch wide.
 2. Vinyl plastic tape, silver gray, flame resistant, vapor barrier sealant tape on rigid and flexible insulation material for warm or cold air ducts. Similar to 3M Company Duct Sealing Tape No. 474.
 3. Aluminum foil tape, dead soft aluminum foil, point seal on stick pin, metal patching, moisture barrier, heat reflecting and general sealing on aluminum facing foil. Similar to 3M Company Aluminum Foil Tape No. 425.
- F. Staples:
1. Staples shall be galvanized clad outward clinching insulation staples.
- G. Insulating cement:
1. Insulating cement shall be a mineral-fiber (wool) ASTM C 195 base material having essentially the same insulating characteristics as the adjacent insulation. Similar to PABCO High Temperature Insulating Cement. Insulating cement shall be applied in layers to a maximum thickness of 1/2 inch at one time. Each layer shall be allowed to dry thoroughly before subsequent layers are applied.
- H. Finishing cement:

1. Finishing cement ASTM C 449 shall be diatomaceous silica thermal insulating materials with a suitable proportion of heat resistant binder, hydraulic setting insulating cement capable of withstanding maximum temperature of 700 degrees Fahrenheit. When mixed with water it shall be a plastic mix suitable for trowel applications and shall present a hard, smooth and durable surface after drying. Similar to PABCO No. 127.
- I. Combination insulating and finishing cement:
 1. Similar to Ryder One Coat or equal.
 - J. Welding studs:
 1. Welding studs shall be capacitor type split pin or TCP tipped insulation pins with speed clips. Similar to Nelson Stud Welding Spec. 28.

PART 3 - EXECUTION

3.1 PREPARATION

- A. No insulation shall be applied until the surfaces of the equipment to be insulated are thoroughly cleaned and until pipes and equipment to be insulated have been leak tested and proven tight and accepted by THE ENGINEER
- B. Insulation shall not be applied to piping or equipment until authorization is given to the Contractor by THE ENGINEER. Contractor shall submit a request for authorization. If any insulation is applied without first obtaining authorization, it will be the Contractor's responsibility to remove the insulation and apply it again if so directed.
- C. Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.
- D. The execution of the insulation work shall be in strict accordance with the best practices of the trade and with the specifications.
- E. The insulation shall be handled and applied in a manner that will not adversely affect its structural or insulating properties.
- F. The installation instructions provided by the insulation material manufacturer of all materials specified in this Section shall be followed when installing these materials. Where the specifications are in conflict with manufacturers' instructions, such conflicts shall be brought to the attention of the ENGINEER for a decision.
- G. Welding operations will not be permitted on certain specific items of equipment, piping and components for the application of studs, pins, support rings, angles, etc. Contractor shall obtain permission in writing from THE ENGINEER to perform any welding.
- H. Coat to seal all insulating cement and calcium silicate surfaces with primer similar to Childers CP-53 or equal before applying any mastic coating.

3.2 PIPING INSULATION INSTALLATION

- A. Ensure insulation is continuous through interior walls. Pack around pipes with fire proof self-supporting insulation material, fully sealed. Insulation on all cold surfaces where vapor barrier jackets are specified must be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, and other heat conductive parts that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.
- B. Insulate fittings, valves, unions, flanges, and strainers. Do not insulate flexible connections and expansion joints. Terminate insulation neatly with PVC or aluminum end caps.
- C. Where two sections of pipe insulation butt together provide a 3 inch wide butt strip of same facing material as adjacent insulation facing. Adhere neatly in place using adhesive ADH-3.
- D. All pipe elbows shall be insulated with short radial and mitered pieces of board or block insulation or premolded pieces of pipe insulation. Each piece shall be butted tightly against the adjoining piece and all joints, seams, voids and irregular surfaces shall be filled with insulating cement finished to a smooth, hard and uniform contour. Coat with MAS-1 mastic and reinforce with ADJ-2 additional jacket. In addition, place a fitted PVC cover (ADJ-4) over insulated elbow exception. Tape elbow to adjoining insulation.
- E. All valves and fittings shall be insulated with premolded fittings, sectional pipe insulation, or blocks of the same material and thickness as used for the adjacent pipe. Flange insulation shall overlap the adjoining pipe insulation by not less than the thickness of the pipe insulation. Sectional pipe covering or block insulation shall be cut to fit, and each section butted closely to the next and held in place with tie wire.
- F. Fittings on pipe lines in finished and concealed areas shall be covered with premolded fiberglass pipe fitting insulators Insul-Coustic or equal, where sizes are available, otherwise, use mitercut segments of molded pipe insulation, wire in place with joints and raw edges sealed with adhesive and smoothed out with a coat of insulating cement.
- G. On cold pipes the fittings shall be finished with (2) coats of an approved vapor barrier mastic, reinforced with glass cloth extending 2 inches onto adjacent pipe insulation. Hot pipes shall be finished in a similar manner except the mastic need not be of the vapor barrier type.
- H. Insulation shall cover the entire surface of the fittings and bodies of the valves up to and including the bonnets, and to the valve stuffing box studs, bolts, or nuts. All joints, seams, and irregular surfaces shall be filled with insulating cement. The insulated surfaces shall be covered with a 1/4 inch thick layer of finishing cement and heavily coated with vapor barrier mastic MAS-1 for cold services and mastic MAS-2 for hot services and reinforced with ADJ-2 additional jacket. Mastic shall

be trowelled to a smooth and well-shaped contour compatible with adjoining pipe insulation jackets as specified.

- I. Use ADJ-4 covers over fittings and flanges everywhere except when ADJ-3a, ADJ-3b, or ADJ-5 is specified.
- J. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship on all joints of all piping.
- K. All instrument connections for thermometers, thermocouples, gauges, test connections, flow meters, etc., on insulated pipes, vessels, or equipment shall be insulated. The insulation shall be shaped at these connections by tapering it to and around the connection with insulating cement and finishing with finishing cement, vapor barrier adhesive, applicable mastic, or caulking compound.
- L. Where removable flange and valve insulation is required or specified, installation shall conform to the following:
 - 1. Removable flange insulation shall be made from sectional pipe insulation of the same thickness as that on the adjoining pipe or from block insulation 1/2 inch thinner than the pipe insulation and finished with insulating cement. Insulation jackets shall be the same as adjoining pipe insulation unless indicated otherwise.
 - 2. When flange covers are made from sectional pipe insulation, they shall enclose the flanges and be long enough to extend at least 2 inches over the adjacent pipe insulation on each side of the flange. The space between the flange cover and the pipe insulation shall be filled with insulating cement. Secure the flange cover in place with stainless steel banding.
 - 3. When flange covers are made from block insulation, they shall be made in two halves. Each half shall consist of mitered blocks wired to 1/2 inch galvanized hardware cloth mesh. This wire frame, with its attached insulation, shall then be secured to the flanges with tie wire. The insulation cover shall be long enough to extend at least 2 inches over the adjacent pipe insulation on each side of the flange. The space between the flange cover and the pipe insulation shall be filled with insulating cement. The whole flange cover assembly shall be finished with 1/2 inch of insulating cement applied in two coats. After the first coat is dry, the second coat shall be trowelled to a smooth hard finish. All surfaces shall then be finished with jackets as specified in the schedule.
 - 4. Removable valve insulation covers shall be constructed in the same manner as for flanges with the following exception; the two part section shall be divided on the vertical center line of the valve body, bonnet, flange or joint.
 - 5. When specified to insulate the complete valve, the hand wheel or lug wrench shall be removed to accommodate the valve bonnet box. The valve bonnet box shall be constructed in a one piece closure, one end closed, one end opened to fit up to the valve body insulation. Securing the valve and

bonnet box sections, sealing and pointing of the insulation shall be done in same manner as specified for flange covers.

6. Unless indicated as removable, a permanent installation as previously specified shall be used.
7. Protect insulation on piping 2 ½” and up where supported in hangers by means of calcium silicate rigid pipe insulation or jackets. Saddles or shaped galvanized steel pieces approximately 10” long by half the circumferences of insulated pipe.
8. All piping shall have been tested and approved prior to installation of insulation.
9. All piping or surfaces where subject to condensation on the outside shall be insulated including vaporseal finish.

PART 4 - SCHEDULES

4.1 PIPING INSULATION SCHEDULE: (ASJ = "All-Service-Jacket")

Service	Type Insulation and Thickness (Inches)	Facing	Additional Jacket*
Refrigerant Piping	1” Armaflex		Two coats of Armaflex protective coating for exterior piping
Condensation Drains	Molded Fiber Glass 1 ½”	ASJ	

*Including elbows, fittings, valves, complete system.

- A. Piping exposed to weather shall be insulated with pipe insulation using double the thicknesses scheduled hereinbefore, up to 24 inches beyond the point where pipes enter the building. Provide weatherproof jacket as hereinafter specified.
- B. Equipment drains and floor drains from cooling coils shall be insulated 6 feet downstream from connection point.

END OF SECTION 230719

SECTION 232001 – HVAC PIPING AND JOINTS
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install piping, fittings, flanges, unions, bolting, gaskets, welding, and threading for all main piping network, branches and connections to all HVAC equipment and systems.
- B. All systems shall be installed in accordance with local code including vent piping and relief discharge termination points.
- C. Secure and pay for all permits and local/state approvals for the installation of all components included under this Section. Arrange for all inspections.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. ASME: American Society of Mechanical Engineers
- C. NFPA: National Fire Protection Association
- D. ANSI: American National Standards Institute
 - 1. A13.1: Scheme for Identification of Piping Systems.
 - 2. B16.1: Cast Iron Pipe Flanges and Flanged Fittings
 - 3. B16.3: Malleable Iron Threaded Fittings
 - 4. B16.4: Cast Iron Threaded Fittings
 - 5. B16.5: Pipe Flanges and Flanged Fittings
 - 6. B16.9: Factory Made Wrought Steel Butt Weld Fittings
 - 7. B16.15: Cast Bronze Threaded Fittings
 - 8. B16.18: Cast Copper Alloy Solder Joint Pressure Fittings
 - 9. B16.20: Metallic Gaskets for Pipe Flanges
 - 10. B16.21: Non Metallic Flat Gaskets for Pipe Flanges

11. B16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 12. B16.24: Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 800, 1500 and 2500
 13. B182.1 Square and hex bolts and screws
 14. B182.2 Square and hex nuts
 15. B16.39: Malleable Iron Threaded Pipe Unions
 16. B16.42: Ductile Iron Pipe Flanges and Flanged Fittings
 17. B31.9: Building Service Piping
 18. B36.10: Welded and Seamless Wrought Steel Pipe
 19. Z49.1: Safety in Welding and Cutting
- E. ASTM: American Society for Testing and Materials
1. A 47: Ferritic Malleable Iron Castings
 2. A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
 3. A 74: Cast Iron Soil Pipe and Fittings
 4. A 105/A105M: Forgings, Carbon Steel, for Piping Components
 5. A 106: Seamless Carbon Steel Pipe for High-Temperature Service
 6. A 135: Electric-Resistance-Welded Steel Pipe
 7. A 153: Zinc Coating (Hot Dip) on Iron and Steel Hardware
 8. A 183: Carbon Steel Track Bolts and Nuts
 9. A193: Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
 10. A194: Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
 11. A197: Cupola Malleable Iron
 12. A 234/A23AM: Pipe Fittings of Wrought Carbon Steel and Alloy / Rev A: Steel for Moderate and Elevated Temperature
 13. A 307: Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength
 14. A 536: Ductile Iron Castings
 15. A 568: Steel, Sheet Carbon and High-Strength Low-Alloy / Rev A: Hot-Rolled and Cold-Rolled, General Requirements
 16. A 795: Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
 17. B 32: Solder Metal

18. B 43: Seamless Red Brass Pipe, Standard Sizes
19. B 75: Seamless Copper Tube
20. B 88: Seamless Copper Water Tube
21. F 36: Compressibility and Recovery of Gasket Materials
22. F 37: Sealability of Gasket Material
23. F 38: Creep Relaxation of a Gasket Material
24. F 146: Fluid Resistance of Gasket Materials
25. F 104: Non-metallic Gasket Materials
26. F 152: Tension Testing of Nonmetallic Gasket Materials

1.5 SUBMITTALS

- A. See Section 232000 and General Conditions for additional information.
- B. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- C. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
- D. Product Data: Include data on pipe materials, steam/condensate specialties, pipe fittings and accessories. Provide manufacturers catalogue information and mill certificates.
- E. Welders Certificate: Include welder's certification of compliance with ASME (BPV IX).
- F. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- G. Project Record Documents: Record actual locations of all piping, valves, traps and valve tag numbers.
- H. Grooved joint couplings and fittings shall be shown on drawings and product submittals and shall be specifically identified with the applicable designation.
- I. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- J. Provide piping plans to a minimum scale of 1/4" - 1'-0".

1.6 QUALITY ASSURANCE

- A. Installer: Company specializing in performing work of the type specified in this section, with documented experience.
- B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

C. Welders: Certify in accordance with ASME (BPV IX).

1.7 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping systems including specialties.
- B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
- C. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Protect piping systems and specialties from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 ENVIRONMENTAL

- A. Do not install piping when environmental conditions are outside the specific limitations of the referenced codes and manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide all piping, fittings, flanges, couplings, unions, bolting, gaskets, welding, threading and soldering for main piping network, branches and connections to equipment as shown on the drawings and as required to provide complete systems. All piping, fittings and accessories shall conform to the appropriate Service Pipe Schedule as specified hereinafter.
 - 1. Acceptable manufacturers contingent on compliance with the specifications.
 - a. Pipe
 - 1) Copper
 - a) Cambridge Lee
 - b) Cerro
- B. General
 - 1. All pipe and fitting shall be new, first quality material suitable for continuous operation under the conditions specified. All material shall be in conformance with ANSI Standards.
 - 2. All pipe shall be a product of the United States of America. Mill certificate shall be provided as required.
 - 3. All piping shall be clearly marked with material specification.

4. All pipe and material shall comply with the requirements and recommended practices of ASME B31.9 Building Service Code (latest Edition and Addenda).
5. Elbows shall be long radius ANSI B16.9 unless otherwise specified.
6. Fittings shall be used at all branch connections from headers.
7. Acceptable fittings shall be tees. "Weldolets", and "Threadolets" will also be allowed as specified. Fishmouth or shaped nipples will not be allowed.
8. Provide drains at low points and vents at high points of all piping systems and between pumps and check valves.
9. Lubricants used for the installation of grooved couplings shall be approved by the coupling manufacturer.
10. All pipe and fittings with threaded ends shall have IPS threads cut clean and true and in conformance with the ANSI B1.20.1.
11. Threaded pipe and fittings shall be made up with special care to avoid marring or damaging pipe and fitting surfaces.
12. All threaded joints in steel and iron pipe shall be made up with pipe thread compound or other compound suitable for design temperature and pressure of piping. All threaded joints in copper pipe shall be made up with Teflon pipe tape, petroleum gas grade, wound on male threads, clockwise as viewed from end of pipe.
13. Provide brass, bronze steel or cast ductile iron (as appropriate) dielectric unions or flanges between dissimilar pipe materials to prevent galvanic action, as required. Gaskets shall be suitable for operation up to design temperature of the piping.
14. No joints shall be "backed-off" to align pipe and fittings.
15. Gauge lines shall be stainless steel with compression fittings.
16. Piping for compressed air for controls shall be copper.
17. Use "Never-Freeze" Copper Anti-Seize by Frederickseal or similar on all flange bolts. Torque all bolts to suitable values using torque wrenches.

2.2 SERVICE PIPE SCHEDULE

Service	Type	Grade	Wall		Joints (Minimum Sch. Shall match Wall)		Test Pressure PSIG
					2" and Less		
Condensate Drain	Hard Drawn Copper	ASTM B88	Type L		DWV 95-5 Solder		
Refrigerant system	Hard Drawn Copper ACR	ASTM B280	Type L		Silver Brazed		---

Note 1: In concealed inaccessible location provide socket welded.

Note 2: Outdoor portion of piping shall be painted with a high temperature rust inhibiting primer and two coats of high temperature enamel paint (color shall be black unless otherwise selected by the architect).

Note 3: Grooved piping systems of standard wall shall be roll grooved according to Victaulic roll groove specification standards. On piping heavier than standard wall, cut grooving required per Victaulic cut groove specification standard. Gasket must be selected for intended service.

2.3 FITTINGS

A. For Copper Tubing

1. Solder Joint: Wrought Copper, ANSI B16.22 or Cast Bronze B16.18.
 - a. 2" and less
 - 1) Silver brazing alloy.
 - a) For refrigerant piping and where noted: Silver brazing alloy, similar to Handy and Harman Easy-Flo.
2. Compression and Flared Fittings: Cast brass, ANSI B16.26.

2.4 FLANGE GASKETS

- A. One-piece ring type 1/16" thick, except as noted.
- B. Suitable for temperature, pressure and service of system.
- C. For Joints of Dissimilar Metals
 1. Isolating gaskets, sleeves, and washers between flanges, bolts and nuts.

2. Gaskets, similar to DuPont Teflon.

PART 3 - INSTALLATION

3.1 PIPING INSTALLATION

- A. Provide all piping systems as shown on the drawings and otherwise required to make a complete, workable and neat job, installing all valves, appurtenances, grooved joint couplings, unions and gaskets. The Contractor shall use care arranging all piping as shown on the drawings and shall carefully examine the arrangements where offsets are indicated and shall follow details as shown.
- B. All piping shall be run to true alignment generally parallel or perpendicular to adjacent building walls, floors and ceilings and with uniform grades and spacing so as to present a neat and workmanlike appearance.
- C. Care shall be paid to the exact locations for all piping and equipment with respect to equipment, ducts, conduits, slabs, beams and lighting fixtures, so as to provide maximum access to all mechanical and electrical equipment in the buildings. Close coordination and cooperation shall be exercised with other Trades in locating the piping and equipment in the best interests of the Owner. The drawings and specifications covering other work to be done in the buildings shall be carefully studied and arrangements made to avoid conflict.
- D. The drawings shall be followed where they are definite and provided such procedure causes no objectionable conditions or does not conflict with other Trades, Laws, Regulations or recommendations of equipment manufacturers. The drawings are intended to indicate the sizes of piping connections and if certain sizes are omitted, or unclear, obtain additional information before proceeding.
- E. Rough in for all equipment requiring connections to the Mechanical work. Obtain all necessary data on exact locations, sizes, connections, fittings and arrangements and exact routings as may be required for proper installation.
- F. Unions, grooved joint couplings or flanges shall be provided in conjunction with all equipment, coils, control valves and specialties in all pipe lines and at all points necessary to provide reasonable access to the piping systems.
- G. Ends of all pipes shall be reamed clean and all pipes shall be straightened before erection and measures shall be taken to preserve this cleanliness after erection.
- H. Support piping independently at all equipment so that the equipment is not stressed by piping weight or expansion.
- I. Arrange piping for maximum accessibility for maintenance and repair, locate valves for easy access and operation.
- J. Provide dielectric unions, waterway fittings or flanges between dissimilar pipe materials to prevent galvanic action as required.
- K. Provide proper provision for expansion and contraction in all portions of pipe work, to prevent undue strains on piping or apparatus connected. Provide double

swings at riser transfers and other offsets to take up expansion. Arrange riser branches to take up motion of riser. Branch runouts to equipment shall have a minimum of (3) elbows, adequately spaced.

- L. All piping connections to equipment shall be made with offsets. Provide with unions, grooved joint couplings and/or flanges so arranged that the equipment can be serviced or removed without dismantling the piping. If equipment, when commissioned, becomes air bound or stratified, all necessary modifications to the piping system required to rectify the condition permanently shall be made to piping and equipment, furring, floors, walls, etc., at the Contractor's expense.
- M. Pipe pitch, unless otherwise indicated on the drawings, shall be as follows:
 - 1. Condensation Drainage:
 - a. Preferred: 1/4 in./ft., down in direction of flow.
 - b. Minimum: 1/8 in./ft., down in direction of flow.
- N. Refrigerant Piping and Connections
 - 1. Provide all refrigeration piping, including thermal expansion valves, driers, moisture indicator sight glasses, shutoff valves, controls, gauges, insulation and other appurtenances, as required to complete the refrigeration system. Piping connections to the units shall be fitted with flexible pipe fittings and renewable unions.
 - 2. The HVAC Contractor shall triple evacuate and field charge entire refrigeration system. All labor and materials required for evacuation, charging, as well as commissioning of the refrigerant systems, shall be provided by the HVAC Contractor. The refrigerant piping arrangement shall be in strict accordance with manufacturer's recommendations. Provide shop drawings indicating sizes and all required components and accessories for Architect's review prior to ordering equipment or installation.
 - 3. All refrigerant piping exposed to weather outside the building shall be properly supported in a manner to allow expansion and contraction. All sleepers provided shall be secured and their installation shall be as directed and approved by the Architect.
 - 4. Refrigerant piping joints shall be made with cadmium free 45% silver brazing filler metal having a melting point of 1225°F. Joint flux, if used, shall be compatible with materials. The outside surface at end of pipe and inside surface of fittings shall be thoroughly cleaned with steel wool or emery cloth, and cut pipe ends shall be reamed and all burrs shall be removed. Care shall be taken to ensure the entry of foreign particles into the system does not occur. While brazing, purge piping with low pressure nitrogen to prevent interior oxidation and to dry the system. Caution must be taken to continuously ventilate the work area and to avoid allowing nitrogen to concentrate in an enclosed area thereby expelling all of the oxygen and causing asphyxiation.

5. Traps shall be factory fabricated one-piece fittings or field assembled 45°-90°-45° elbows. Do not use 90°-90°-90° elbows.

3.2 CLEANING AND BLOWING OUT

- A. The equipment and piping installed under this Section shall be blown out under pressure and cleaned of foreign matter, through temporary connections where necessary, before the system is placed in service. Precautions shall be used to prevent foreign matter from getting into equipment and piping during construction. The supplier of water treatment equipment and chemicals shall recommend and furnish chemicals for the purpose of cleaning and blowing out of all systems. All chemicals, materials, instruments and labor shall be provided by the Contractor.
- B. The surfaces of all equipment and piping shall be clean upon completion of the work.
- C. All pipe line strainers shall be cleaned immediately before being turned over to the Owner for acceptance.
- D. During cleaning process, hammer welds to remove scale, weld slag and other debris.

3.3 TESTING

- A. Furnish all labor, material, instruments, supplies and services and bear all costs for the accomplishment of the tests herein specified. Correct all defects appearing under test and repeat the tests until no defects are disclosed; leave the equipment clean and ready for use.
- B. Perform all tests other than herein specified which may be required by Legal Authorities or by Agencies to whose requirements this work is to conform.
- C. Furnish all necessary testing apparatus, make all temporary connections and perform all testing operations required, at no additional cost to the Owner.
- D. All equipment and piping installed under this Contract shall be tested and found tight. Insulated or otherwise concealed piping shall be tested before being closed in. All leaking joints shall be corrected, retested and found tight. Such tests shall conform to the requirements of Local Codes but shall not be less than the equivalent of the tests called for herein. Threaded joints that leak shall not be seal-welded to correct leakage.
- E. Tests performed shall not relieve the Contractor of his responsibility for leaks which may develop after the tests are made.
- F. All piping systems shall be subjected to a hydrostatic test at the scheduled test pressure for a period of (4) hours without drop in pressure.
- G. Tests of piping systems shall be conducted before connections to equipment are made and before piping is covered, buried or otherwise concealed.
- H. Systems found to have leaks shall be subjected to further tests when faulty joints have been repaired or replaced.

- I. Welded joints shall be subjected to a hammer test while under pressure.

END OF SECTION 232001

SECTION 233100 – SHEET METAL WORK AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install a complete system of air distribution, including accessories, to all areas indicated on the contract documents.
- B. Create, coordinate and submit ¼” scale Coordination Drawing in accordance with Section 230500.
- C. Provide all ductwork, fittings and accessories to make a complete and operational system in all respects.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. ASTM A 36/A 36 M – Standard Specification for Carbon Structural Steel.
 - 2. ASTM A 1008/A 1008M – Standard Specification for Steel, Sheet, Carbon, Cold Rolled, Commercial Quality.
 - 3. ASTM A 1011/A 1011M – Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
 - 4. ASTM A 653/A 653M – Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
 - 5. ASTM A 666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 6. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 7. ASTM B 209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

8. ASTM C 443 – Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
9. ASTM C 443M – Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric).
10. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.
11. NFPA 90B – Installation of Warm Air Heating and Air Conditioning Systems.
12. NFPA 96 – Installation of Equipment for the Removal of Smoke and Grease-laden Vapors from Commercial Cooking Equipment.
13. SMACNA (LEAK) – HVAC Air Duct Leakage Test Manual.
14. SMACNA (DCS) – HVAC Duct Construction Standards – Metal and Flexible.
15. UL 181 – Factory-Made Air Ducts and Connectors.

1.5 SUBMITTALS

- A. See Section 230500 and General Conditions for Additional Requirements.
- B. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- C. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
- D. Product Data: Provide data for duct materials, duct connectors and all accessories. Include sound attenuator test data in accordance with ASTM E477.
- E. The Sheet Metal Contractor shall submit duct fabrication standards and methods of installation, in compliance with SMACNA and these specifications, for review and approval by the Architect, clearly indicating the combination of metal gauges and reinforcement intended for use for each pressure classification. Duct fabrication shall not be allowed until a satisfactory review of this Standard has been performed and fabrication drawings have been reviewed and coordinated. Merely submitting copies of the SMACNA pressure class tables does not comply with this requirement.
- F. Provide scaled ductwork fabrication drawings. Fabrication drawings shall be double line and as a minimum include elevations, dimensions, sizes, all offsets rises and drops, air distribution devices.
- G. Provide scaled ductwork coordination drawings for all floors and systems in accordance with Section 230500, Submittals.
- H. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA– HVAC Air Duct Leakage Test Manual.

- I. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.
- J. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meet or exceed recommended fabrication and installation requirements.
- K. Project Record Documents: Record actual locations of ducts, duct fittings and all accessories. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

- A. All ducts and fittings shall be manufactured by a sheet metal fabrication company whose primary business experience is the manufacture of commercial and industrial quality ducts and fittings. Sheet Metal Contractor shall have adequate experience of building ductwork of the types required for this project as well as successful experience with projects of similar scope. Bids from sheet metal shops which do not meet the specified requirements shall not be acceptable.
- B. No Ductmate, Ward, Nixon or similar factory made slip-on connections will be permitted.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants when temperature is less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

1.8 REFERENCES

MASSACHUSETTS BUSINESS LICENSURE (271 CMR)

- A. The Sheet Metal Contractor must have a business licensure, according with the state requirements of 271 CMR, for projects within Massachusetts.

PART 2 - PRODUCTS

2.1 SHEET METAL WORK

A. General

- 1. Acceptable Manufacturers (Provided they are in compliance with these specifications)
 - a. Sheet Metal
 - 1) All ducts and fittings shall be manufactured by a sheet metal fabrication company whose primary business experience is the manufacture of commercial and industrial quality ducts and fittings. Sheet Metal Contractor shall have adequate experience of building ductwork of the types required for

this project as well as successful experience with projects of similar scope. Bids from sheet metal shops which do not meet the specified requirements shall not be acceptable.

- b. Sheet Metal Accessories
 - 1) Access Doors
 - a) Ruskin
 - b) Air Balance
 - c) Hart and Cooly
 - d) Ductmate
 - 2) Flexible Connectors
 - a) Ventlock
 - b) Elgen Manufacturing
 - c) Duro Dyne
 - d) Ventglass
 - 3) Flexible Ductwork
 - a) Clevepak Corp.
 - b) Flexible Technologies
 - c) Unaflex Rubber Corp.
 - d) Flexmaster
 - 4) Balancing Dampers (OBD)
 - a) Ruskin
 - b) Young Regulator
 - c) Prefco
 - d) Greenheck Fan Corp.
 - e) Nailor Industries
 - f) NCA Manufacturing Inc.
 - 5) Small Balancing Damper less than 48x12
 - a) Ruskin
 - b) Young Regulator
 - c) Ventlock
 - d) Duro Dyne

2. Unless otherwise noted, all supply, return and exhaust air ductwork of all types shall be constructed of galvanized sheet metal based on the "Pressure Class" indicated in the "Minimum SMACNA Construction Standards" table found hereinafter.
3. The drawings are diagrammatic and indicate the arrangements of the principal apparatus, ductwork and piping and shall be followed as closely as possible. Because of the scale of the drawings, it is not possible to show all offsets, rises, drops, rises, fittings, accessories, etc. The Contractor shall carefully investigate the structure, finish conditions, and the work of other trades affecting the work and arrange ductwork, piping, equipment, accessories, etc. accordingly. Provide the best possible arrangement so as to provide the maximum headroom and access to apparatus while providing the minimum resistance to airflow. This work and any extra fittings and offsets required shall be included in the project without extra charge.
4. In addition to sheet metal ductwork provided under this Contract furnish and/or install accessories and devices furnished by others, including but not limited to smoke detectors. Provide and install miscellaneous sheet metal work including safing, mixing baffles, and blank off panels at unused louver areas.
5. All duct systems specified to be installed under this Contract, shall conform to the drawings, specifications, Standards, details and recommendations of the latest Edition of SMACNA "HVAC Duct Construction Standards - Metal and Flexible"; and "Round and Industrial Duct Construction Standards" (hereinafter referred to as Duct Manual). Where the requirements under this Section exceed the requirements of the Duct Manual, the specification shall govern. Wherever the word "should" appears, replace with the word "shall".
6. The Sheet Metal Contractor shall submit duct fabrication standards and methods of installation, in compliance with SMACNA and these specifications, for review and approval by the Architect, clearly indicating the combination of metal gauges and reinforcement intended for use for each pressure classification. Duct fabrication shall not be allowed until a satisfactory review of this Standard has been performed. Merely submitting copies of the SMACNA pressure class tables does not comply with this requirement.
7. All galvanized steel sheet metal shall conform to ASTM A653/A653M (G-90) having not less than 1.25 oz. of zinc on each side of each square foot of sheet. All other duct materials shall be as hereinafter specified as applicable to this Contract.
8. The Sheet Metal Contractor shall install all duct mounted smoke detectors.
9. The Sheet Metal Contractor shall furnish and install all plenums with automatic or manual dampers attached to louvers.

10. The Sheet Metal Contractor shall fabricate and install all canopy hoods, flexible "elephant trunk" exhaust outlets as detailed or noted in the Construction Documents.
11. The Sheet Metal Contractor shall furnish and install exhaust ductwork from emergency generator outlet to exhaust louver including transitions, drains, access doors, flexible connections and baffles to isolate intake from exhaust.
12. There will be no supply and/or return air system ductwork internally lined unless otherwise noted.
13. The Sheet Metal Contractor shall clean and provide temporary caps on all ductwork during installation to prevent dust, dirt and debris from entering ducts during construction, including during shipping, handling and storage in the field.
14. All shop applied fabrication labels shall be applied to the exterior of the ducts. The Sheet Metal Contractor shall remove any material applied to the inside of the ducts before installation.
15. All inline fans shall have companion flanges intake and discharge for removal for servicing.

3.2 DUCT CONSTRUCTION

A. Duct Construction Schedule

1. Industrial Class 1: Includes non-abrasive applications, i.e., make-up air, general ventilation, gaseous emissions.
2. Industrial Class 2: Includes applications with moderately abrasive particulate in light concentrations, i.e., buffing and polishing, woodworking, grain dust, etc.
3. Industrial Class 3: Includes applications with highly abrasive particulate in low concentrations, i.e., abrasive cleaning operations, dryers and kilns, boiler breeching, sand handling, etc.
4. Industrial Class 4: Includes applications with highly abrasive particulate in high concentrations, i.e., materials conveying high concentrations of particulate in all examples listed in Class 3 such as steel mills, foundries, mining and smelting.
5. Systems under positive pressure can be specified as industrial construction when required.

Minimum SMACNA Construction Standards

Ductwork Location	Pressure Class Inches W.G.	Seal Class	Leakage Class	Material	Sound Lining	Table Notes
General exhaust	-3	A	4	G-90	No	2

Table Notes
1 -None
2 Ductwork in the following locations shall be constructed of aluminum or stainless steel and continuously welded (Joints & Seams) and pitched back to the outlets.
· Within 20'-0" of a shower area exhaust.
· Within 20'-0" downstream and 5'-0" upstream of a duct humidifier.
· Within 20'-0" of a sterilizer area exhaust.
· Within 15'-0" of an outside air intake.
· Within 20'-0" of a cartwasher exhaust.
· Within 20'-0" of a locker room and within room (exhaust).
· Within 20'-0" of a locker room and within room (supply).

3.3 ADDITIONAL CONSTRUCTION REQUIREMENTS

A. Minimum Requirements

1. The minimum gauge for any steel duct over 2" or under -2" pressure class shall be 24 gauge except when specified heavier.
2. The minimum thickness of any aluminum duct shall be 0.040".
3. The minimum diameter of any tie rod shall be 1/2".
4. The maximum tie rod spacing shall be 42" unless specifically engineered in accordance with the SMACNA Industrial Rectangular Duct Standard.
5. When tie rods intersect, they shall be welded to each other.
6. No ductwork shall be constructed to less than ± 2 " w.g. This means nothing is constructed to a standard between -2" w.g. and +2" w.g.
7. Duct dimensions indicated are clear inside dimensions. The sheet metal dimensions shall be increased to accommodate internal liner where liner is required.

- B. All joints and seams in all ductwork and casings shall be sealed to SMACNA Seal Class "A". In finished areas, sealing compound shall be neatly applied to exposed ductwork and bands shall be provided over, to cover the sealant.
1. Some SMACNA constructions may not be suitable for the leakage classes specified even though they may meet the pressure class and should not be used.
 2. Seal class A Welded means all welded (i.e. transverse joints, longitudinal seams, spiral seams, fire dampers, volume dampers or any accessories) and in addition it means continuously welded.
 3. All sealants, adhesives and coatings shall be of approved kinds and qualities for each point of application, complying with recommendations for the use and storage.
 4. The method of installation and materials for sealing the ductwork shall be submitted by the Sheet Metal Contractor for review and approval by the Architect, as part of the ductwork construction standards and installation submittal.
- C. All longitudinal seams in all ductwork in excess of +2" w.g. or less than -2" w.g. pressure class shall be made with formed Pittsburgh locks.
- D. Grooved seam/flat lock/pipe lock joining methods is restricted to 2" W.G. pressure class only.
- E. Button punch-snap lock seams are not to be used.
- F. Concealed stainless steel ductwork shall have an ASTM mill rolled No. 1 or No. 2 D finish. Exposed stainless steel ductwork shall have an ASTM mill rolled No. 2 B finish, or higher grade as required by the Architect, with all welds ground smooth and final brushed with stainless steel wire brushes. All welds on exposed stainless steel ductwork shall be free of stain, burn-through, or discoloration to the satisfaction of the Architect.
- G. Tie rods shall not be used in any plenum or large duct requiring internal access or use as an access pathway.
- H. All ductwork required to be removable shall be companion flanged SMACNA Type T-22 for ductwork constructed to SMACNA Metal Duct Standard and companion flanged in accordance with Industrial Standards for ductwork required to be constructed to Industrial Standards.
- I. Elbows
1. All dust collection ductwork elbows shall be a centerline radius equal to (2) duct widths or diameters. No reduction shall be allowed.
 2. Radius elbows shall be used wherever possible. Where it is impossible or impractical to install a 1.5 times width to centerline radius of elbow (full radius elbow) lesser radii configurations shall be used, each with "radius-proportional" splitter vanes permanently installed within. No radius shall be

less than 1.0 times the width. Provide square elbows in rectangular ducts with double thickness vanes with a minimum radius of 4 1/2". Square elbows may only be used when radius elbows will not fit and where specifically approved by the Architect prior to fabrication and/or as required by coordination shop drawings. All offsets shall be of the radius type.

- J. Auxiliary drain pans.
 - 1. Provide 1 1/2" deep auxiliary drain pans under any units with cooling coils located above hung ceilings.
 - 2. Pans shall be 6" larger than equipment in all directions.
 - 3. This includes but not limited to all fan coil units.
 - 4. Drains shall be piped to floor drains or utility sinks.
- K. All rectangular dampers shall be opposed blade and each shall be controlled by an approved galvanized locking quadrant indicating the damper position, as detailed on the drawings.
 - 1. Volume dampers installed into ductwork that is specified to be externally insulated shall have extended activator/handle rods with extension bracket such that adjustment of the damper handle will not disturb the insulation.
- L. Submit the sheet metal shop drawings to the Balancing Contractor of the project for his review and placement of dampers with the final balancing procedures and requirements in mind.
 - 1. Coordinate the location and areas with the Balancing Contractor, and fabricate the ductwork system accordingly.
 - 2. Provide any and all balancing dampers required by the balancing contractor at no additional cost.
- M. In addition to SMACNA requirements, all round ductwork, if used in lieu of rectangular supply and/or return/exhaust systems shall conform to SMACNA.
 - 1. The use of flat oval ductwork shall be acceptable only with prior written approval of the Architect. Note: Flat oval shall not be used under negative pressure.
 - 2. Round duct shall be manufactured of spiral lock seam. Ductwork up to 12"Ø and 2" w.g. pressure class can be manufactured with longitudinal lock seams.
 - 3. All tees shall be conical.
 - 4. All laterals shall be straight.
 - 5. All taps through 10" diameter in size shall have a machine drawn entrance and all fittings shall have longitudinal seams, continuous-welded. Both sides of all welds shall be primed with zinc chromate.

6. All tap entrances shall be free of weld build-up.
7. Elbows in diameters 3" through 10" shall be 2-section stamped or pleated elbows. Larger elbows shall be gored construction. Elbows shall be fabricated to a centerline radius of 1.5 times the diameter. All gored elbows shall be fabricated according to the following schedule:

<u>Elbows</u>	<u># of Gores</u>
Up to 35°	2
36° to 71°	3
Over 71°	5

8. All field joints in diameters through 48" shall be made with a 2" long slip-fit or sleeve coupling provided assembly is not hindered. Ductwork over 48", and for all sizes where disassembly and removal is required, shall be joined with Vanstone or shop fabricated flanges.
9. All flanges and taps into spiral ducts shall be factory or shop fabricated and installed as hereinbefore specified. Shipment of loose flanges or taps for field installation shall be avoided.
10. All access doors for round duct shall be furnished by the access door manufacturer. Round duct access doors shall be of low leakage sandwich type suitable for systems up to 8" pressure, positive or negative. Round duct access doors shall be insulated and shall be equivalent to Ruskin model ARDD.
11. Unless specifically noted otherwise or required by special constraints, all elbows on ductwork changing direction from vertical to horizontal shall be 1.5 times radius.

3.4 ACCESS DOORS

- A. Provide access doors and frames in all supply, exhaust and return ductwork as required, to permit access to:
 1. Automatic dampers
 2. In-box heating coils
 3. Fire dampers
 4. In-duct coils
 5. All plenums
 6. In-duct humidifiers
 - a. Provide sight doors
 7. Other similar equipment

8. Fan Bearings enclosed in ducts.
 9. Duct smoke Detectors
 - a. Provide sight doors
 10. For cleaning and inspection purposes
 11. Where indicated on the drawings
- B. Door Size
1. Ductwork
 - a. Minimum 16" x 12"
 - b. In ducts smaller than 12" they shall be 10" x 6" less than duct width except:
 - 1) Terminal Box heating coil door may be 10" x 6"
 - c. Vacuum cleaning access door shall be 12" round.
 2. Plenums
 - a. Shall be 20" x 56"
 - 1) 18" x 45" door may be used only when 20" x 56" will not fit.
 - b. Larger door shall be provided if required for equipment removal. Coordinate with equipment.
- C. Door Construction
1. Doors shall match material type and gauge of the duct system in which they are installed. This includes hardware such as bolts.
 2. Minimum gauge shall be 20.
 3. Pressure tested to □15" wc
 - a. Leakage shall be zero at □10" wg
 4. Provide a neoprene gasketed around their entire perimeter.
 5. Where sight doors are required, a wire reinforced safety glass shall be utilized.
 - a. All humidifiers
 6. Insulated or lined ductwork shall have insulated door
 7. Insulated plenums shall have insulated door
 8. Insulated doors shall be double wall.
 9. Insulation between the metal panels shall be of the same thickness as the duct or panel adjacent to the access doors.
 10. Plenum access doors shall be hung on heavy hinges and shall be secured in the closed position by means of latches.

11. Ductwork access doors shall be clamp type with a retaining chain or cable.
12. Ductwork access doors shall be similar to Ductmate Sandwich access door.
13. All plenum hinge doors shall be submitted with test (provide E leakage) data before approval.
14. All fire damper access doors in all positive pressure supply ductwork of +3" w.g. or greater construction:
 - a. Shall be of the pressure relief (negative pressure) spring loaded type. Design shall incorporate self-closing spring latch or be complete with secure retainer chain and "D" handle.
 - b. These doors shall be mounted downstream (after shutoff) of fire dampers, fire/smoke dampers or smoke dampers or similar automatic shutting devices.
 - c. These doors shall be of the automatic reset type and similar to Ruskin model ADHP-3.

3.5 FLEXIBLE CONNECTIONS (FANS)

- A. Provide flexible connections of 4" minimum fabric width
 1. Between ductwork and the inlets and outlets of all fans except:
 - a. Hazardous exhausts
 - b. Lab exhaust fans located indoors.
 2. Equipment equipped with fans
 3. All ductwork that crosses building expansion joints.
- B. The connections shall be placed as close to the equipment as practical except at fan suction connections and the clear gap at rest shall be not less than 3". At fan suction connections, locate flexible duct connection at least 3 duct diameters away from fan inlet connection.
- C. There shall be no tension of the fabric under static or dynamic loads
- D. All fabric for flexible duct connections to equipment shall be a minimum of 22 oz. glass fabric, double coated with neoprene, fire retardant, waterproof, airtight, and approved by UL, similar to Ventfabrics or Ventglass.
- E. Exterior flexible connection shall be insulated type similar to Duro Dyne.
- F. Flexible connections shall be fabricated from approved flameproofed fabric conforming to NFPA 90A. Asbestos shall not be acceptable.
- G. Flexible connections shall be installed further upstream from fan powered equipment (in the main duct size) to prevent obstruction of the fan inlet due to suction of the fabric into the airstream.

- H. Ductwork shall be increased in size where the flexible connections are located to prevent fully drawn in connections from blocking any duct area. Submit detail for review.

3.6 FLEXIBLE DUCTWORK

A. General

- 1. Flexible duct runs must not exceed 5'-0" in length. Flexible duct shall not exceed a maximum of 1/2" sag per linear foot when installed horizontally.
- 2. Flexible ductwork shall be supported at a maximum spacing of 2'-6", and as detailed on the drawings. Ductwork must not be compressed. Duct elbows must not exceed 45°.

B. Flexible Duct (Rigid)

- 1. Flexible duct shall be similar to Flexmaster Triple Lock Buck Duct Flexible Air Duct. Flexible duct (insulated) shall be UL 181, Class 0 listed air duct and constructed in accordance with NFPA 90A and 90B. It shall have a smoke/flame spread rating of 50/25.
- 2. Triple Lock Buck Duct shall be made from a tape of dead soft aluminum sheet, spiral wound into a tube and spiral corrugated to provide strength and stability. The joint shall consist of a triple lock that is mechanically performed without the use of adhesives to make a durable airtight seam. A double lock is not acceptable.
- 3. Insulated flex shall have a gray fire retardant polyethylene outer jacket with an 8 oz. density, 1 1/2" thick fiberglass insulation blanket, factory wrapped.
- 4. The flexible duct shall be supported as required.
- 5. Flexible ductwork shall be rated at 12" positive pressure. Duct from 3" to 16" shall have a negative pressure 12" and duct from 18" to 20" shall have a negative pressure of 8".
- 6. All flexible duct shall be individually cartoned and labeled for delivery to the job site for maximum protection.
- 7. Provide:
 - a. Where indicated in construction greater than +2" or less than -2".
 - b. Upstream of supply boxes.
 - c. Downstream or upstream of exhaust boxes when allowed.

3.7 DAMPERS

A. General

- 1. The minimum damper requirements shall be as indicated in the following table:

Damper Construction Table						
Type	Approach Velocity (FPM)	Pressure Rating	Instantaneous Pressure Rating	UL555 S Leakage Class	Blade Type	Listing
Isolation dampers (at units)	4,500	8" w.g.	20" w.g.	I	Air Foil	
Automatic dampers (AD)	4,500	6" w.g.	14" w.g.	I	Air Foil	N/A
Balancing damper in ducts less than 48" by 12" (VD or as specified)	2,500	2"	N/A	N/A	OBD	N/A

B. Automatic Dampers

1. All automatic dampers shall be furnished by the Sheetmetal Contractor. Dampers shall be single or multiple blades as required. Dampers shall be installed by the Sheetmetal Subcontractor, under the supervision of the Temperature Control Subcontractor. All blank-off plates and conversions necessary to install smaller or larger than duct size dampers shall be the responsibility of the Sheetmetal Subcontractor. All dampers shall be equal to Ruskin Models CD-50 (rectangular) or CDR-25 (round).
2. All damper frames shall be constructed of extruded aluminum with 5" x 1" x 1.25" extruded aluminum and shall have flanges for duct mounting. All multiple damper sections must have jackshafts.
3. Damper blades shall not exceed 6" in width. All blades shall be of extruded aluminum airfoil type construction, fabricated from 6063-T5 aluminum. Blades shall be suitable for high velocity performance, ultra-low leakage type, with leakage not greater than 6.2 cfm/sq.ft. at 4" w.g. pressure differential for 48" x 48" damper size, as published and certified under AMCA Certified Ratings Program. Damper leakage shall be less than 0.1% of total CFM at maximum damper system velocity.
4. All damper bearings shall be made of nylon or molded synthetic, bushings that turn in the bearings are to be oil impregnated sintered metal.
5. Replaceable butyl rubber seals shall be provided with the damper. Seals shall be installed along the top, bottom and sides of the frame and along each blade edge. Seals shall provide a tight closing, low leakage damper. Leakage and flow characteristic charts must be submitted to the Engineer prior to approval of dampers.
6. The HVAC Contractor shall provide an access door upstream and downstream of each automatic damper location.

Device	Furnished By	Installed By	Actuator By	Actuator Type	End Switches	Control Air	Control Wires	Power	UL Assembly
Automatic Damper (AD)	ATC	HVAC	ATC	Pneumatic	ATC	ATC	N/A	ATC	No
Automatic Damper (AD) (When noted to be electric)	ATC	HVAC	ATC	Electric	ATC	N/A	ATC	ATC	No

PART 3 - EXECUTION

3.1 SHEET METAL INSTALLATION

- A. All ductwork shall be installed to true alignment, generally parallel or perpendicular to adjacent building walls, floors and ceilings, so as to present a neat and workmanlike appearance. All fabricated, stored and installed ductwork shall be protected with removable caps, plastic or other means to prevent dirt, water and debris from entering duct system. The Sheet Metal Contractor shall be responsible for maintaining a clean duct system and shall clean and/or replace any ductwork identified by the Owner or Architect as being deficient or dirty. The Sheet Metal Contractor shall be responsible for all costs associated with the temporary protection cleaning and/or replacement of ductwork. All fabrication labels shall be applied to the exterior of the duct. The Sheet Metal Contractor shall be responsible for the removal of all internal labels if such labels were incorrectly applied.
- B. Care shall be paid to the exact locations of all sheet metal work with respect to equipment, ducts, conduits, piping, slabs, beams, columns, ceiling suspension systems, lighting fixtures and electrical, plumbing and fire protection systems in the building. Close coordination and cooperation shall be exercised with other Trades in locating the piping and equipment in the best interests of the Owner.
- C. The drawings and specifications covering other work to be done in the building shall be carefully studied and arrangements shall be made to avoid conflict.
- D. The drawings shall be followed where they are definite and provided such procedures do not cause objectionable conditions for equipment provided installed under this Contract. The drawings are intended to indicate the sizes of ductwork and if certain sizes are omitted or unclear, obtain additional information before proceeding.
- E. Locate and size all openings for ductwork in the building construction. Provide all sleeves as hereinbefore specified.
- F. Provide access doors in ductwork at the following locations:
- G. Both sides of all coils
 - 1. Both sides of automatic dampers

2. Humidifiers
 3. Both sides of filters
 4. At a maximum of 20'-0" and at every change in direction in kitchen exhaust system and/or as required by code.
 5. At all exhaust and intake plenums, doors shall allow full body access in all plenums over 4'-0" tall.
 6. Otherwise indicated or specified
- H. Provide labels with a minimum of 1" high red letters on white background. Each access door shall be labeled as follows (or worded as required by Code):
1. Automatic Damper
 2. Humidifier
 3. Filter Access
- I. The installation of special items of equipment in the duct systems, including automatic dampers, thermostats, thermometers, duct airflow measuring devices and other related controls, shall be done by this Contractor under the direct supervision of the manufacturer of such controls.
- J. All elbows, tees and branch takeoffs in round ductwork shall be made of the same materials as the ductwork.
- K. Duct connections to equipment shall be in no case smaller than the equipment openings.
- L. All openings for pitot tube traverses shall be fitted with neat removable plugs or caps. As a minimum, such openings shall be provided at every fan inlet and at such other points as may be required for airflow measuring and balancing. Coordinate the location of plugs and caps with the Balancing Contractor.
- M. All internally lined duct sections and joints shall be closely inspected by the contractor before and after each piece is erected. Loose edges, open joints, damaged areas and other defects shall be sealed securely so as to insulate all metal surfaces and so as to endure without falling in the presence of moving air. All liner applications shall comply with SMACNA "Duct Liner Application Standard".
- N. Provide other miscellaneous sheet metal work shown on the drawings including blanking off portions of louvers not required for the specific usage and diffusion plates or mixing air scoops to allow for air mixing where job conditions require the provision of same. All above work shall be provided as part of this Contract at no extra cost to the Owner.
- O. Where applicable and as approved by the Architect, all exposed ductwork shall be installed in a workmanlike manner to result in a neat appearance with no visible penetrations, screws, or other sheet metal imperfections.
- P. Install all UL classified devices in accordance with their UL approved installation sheets.

- Q. Counterflashing of duct penetrations through roof shall be provided under this Contract.

3.2 DUCT HANGERS AND SUPPORTS

- A. Provide suitable angle iron/strap hangers and supports inside the mechanical shafts, mechanical rooms and in ceilings of the buildings, and on the roof(s) as shown on the drawings (Architectural/HVAC). This work shall be performed as required by job conditions and as instructed by the Architect in the field to support all air distribution ductwork and devices in both horizontal and vertical planes.
- B. When hanging and supporting the ductwork, the following shall be complied with:
1. Except as otherwise noted, ductwork up to 42" in greatest dimension shall be hung by using sheet metal bands secured as a minimum at (2) locations to the vertical sides of the ductwork and at (1) location under the duct.
 2. All support systems shall be compatible with the building structure and roofing system as approved by the Architect.
 3. Where ductwork major axis dimension is larger than 42", ductwork shall be hung by using rods of not less than 3/8" soft steel secured to angle iron trapeze support frame around ductwork with threaded nuts for securement and adjustment. All rods used on ductwork exposed in finished spaces shall be plain smooth rods threaded only at the ends.
 4. Ductwork shall be securely attached to the building construction. The hanger design and spacing shall be governed by the major duct dimension and shall be in accordance with SMACNA Duct Manual, except as modified hereinbefore. Vertical ductwork shall be supported at each floor level in an approved manner using angles or channels attached to the ducts. The installation, when complete and under operating conditions, shall be free from chatter or vibration. If necessary to achieve this, additional supports and/or bracing shall be furnished without extra cost to the Owner. Supports and bars and similar items shall be primed and painted structural steel. Touch up with aluminum paint any surfaces where galvanizing is destroyed on indoor ductwork, zinc primer on exposed ductwork with a final coat of aluminum paint. Provide vibration isolation hangers where specified under Vibration Isolation Section of these specifications.
 5. The Sheet Metal Contractor shall provide all supplemental steel required to support the ductwork in shafts, mechanical rooms or on the floor where structural steel is not properly positioned. Beam clamps shall be double sided.
 6. The maximum hanger spacing shall be 10'-0" on centers and additionally on each side of an elbow or change-in-direction fitting.

7. In addition to the above, provide supports on each side of any duct mounted device, fans, coils, flow measuring stations, framed dampers, etc., to permit removal of the device without disconnecting adjacent duct sections.
8. Provide angle sway bracing to the structure wherever lateral loads would be imposed on the ductwork, including but not limited to:
 - a. Elbows downstream of fan discharges.
 - b. Ductwork exposed to the weather subject to wind loads.
9. Ductwork mounted on the roof or otherwise exposed to the elements shall be supported with frames constructed of steel angles and channels regardless of duct size.
 - a. Coordinate all roof supports with General Contractor.
 - b. Provide diagonal cross bracing between supports as required to sustain maximum area wind loads as dictated by the Architect.
10. The Sheet Metal Contractor shall provide expansion compensators, anchors and guides on all high temperature ductwork (breeching, high temperature supply/exhaust) as required.

3.3 SHEETMETAL TESTING

A. General

1. All ductwork that is required to be tested shall be tested on regular intervals as the job proceeds and shall be completed prior to enclosure in shafts, above ceilings or behind walls.
2. The Sheet Metal Contractor shall keep an up-to-date log of the ductwork tested for review by the Architect. The Sheet Metal Contractor shall notify all other Contractors when the testing is completed and accepted to permit enclosure of ducts.
3. The Sheet Metal Contractor shall furnish and install all blank off plates, blind flanges, safing, etc., necessary to isolate each section of duct being tested for leakage.
4. The Sheet Metal Contractor shall submit for review all proposed testing procedures, sample report, and equipment to the Engineer prior to proceeding. Additionally, the Sheet Metal Contractor shall notify the Engineer when testing is to occur so that the test can be witnessed at the Engineer's option.
5. All test equipment shall be calibrated per ANSI Standards prior to testing. Certified test reports shall be submitted to the Architect prior to commencement of the testing.
6. Testing Procedure

- a. The testing procedure shall be in accordance with SMACNA "HVAC Air Duct Leakage Test Manual".
- b. The test pressure shall be the specified construction pressure of the duct system.

7. Scope of Testing

- a. All ductwork (regardless of pressure class) that will be in inaccessible areas including, but not limited to, all ducts within shafts, above hard ceilings, and those that will be made inaccessible by the work of other Trades. (This shall include ± 2 " w.g. construction.)
- b. All ductwork constructed to greater than +2" w.g. or less than -2" w.g.
- c. All other sheet metal in duct systems constructed to ± 2 " w.g. shall be tested under normal fan pressure and shall not leak sufficiently to cause audible leaks or blowing detectable by hand. If, in the opinion of the Architect, the ductwork does not appear to be constructed and/or sealed to the approved shop standards, the Architect may request any or all of this ductwork to be tested at the specified construction pressure.
- d. Allowable Leakage
 - 1) The total allowable leakage shall be less than specified leakage class with no audible leaks.
 - 2) If no leakage class is listed elsewhere, the system shall meet leakage Class 4.

3.4 DUCT CLEANING

- A. Clean dust and debris from interior and exterior of all ducts using wet rags and vacuums.
- B. Cover open ends of ductwork when installation does not proceed for more than one day. This requirement shall apply to each individual run of duct, such that no duct section shall remain open or unconnected for more than 8 hours.

END OF SECTION

SECTION 233700 – REGISTERS, GRILLES AND DIFFUSERS
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all registers, grilles and diffusers including opposed blade dampers, frames and other accessories to make a complete system of air distribution.
- B. All materials shall be new and manufactured for the specific purpose of distributing and controlling air flow.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as following:
 - 1. ADC 1062: GRD – Test Code for Grilles, Registers and Diffusers; 1984.
 - 2. AMCA 500 – Test Method for Louvers, Dampers and Shutters; 1989.
 - 3. ASHRAE 70 – Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
 - 4. NFPA 90A – Installation of Air Conditioning and Ventilating Systems; 1993.
 - 5. SMACNA (DCS) – HVAC Duct Construction Standard – metal and Flexible; 1995.

1.5 SUBMITTALS

- A. See Section 2300500 and General Conditions for Additional Requirements.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application and noise level.

- C. Project Record Documents: Record actual locations of air outlets and inlets.
- D. Submit air terminal performance data including static pressure, throw, velocity, airflow and acoustical performance. Data must indicate compliance with referenced Codes and Standards specified herein.
- E. Manufacturer shall review requirements of outlets as to size, finish and type of mounting before submitting shop drawings and schedule of outlets.
- F. Manufacturer shall check location of outlets and make necessary adjustments in position to conform with architectural features, symmetry and lighting arrangement before submitting shop drawings.

1.6 QUALITY ASSURANCE

- A. Manufacturer shall certify cataloged performance and ensure correct application of air outlet types.
- B. Manufacturer shall be responsible for examining application of each outlet and shall guarantee that each will provide comfortable space conditions without drafts at noted capacity.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Acceptable manufacturers contingent on compliance with specifications.
 - 1. Anemostat
 - 2. Krueger
 - 3. Tuttle & Bailey
 - 4. MetalAire
 - 5. Price
 - 6. Nailor
 - 7. Titus
- B. All air distribution devices shall be of steel or aluminum construction unless otherwise specified herein or scheduled on the drawings.
- C. Distribution devices, except where such devices are specified or scheduled to be steel extruded aluminum, shall be factory primed and finish painted by the manufacturer in a color as approved by the Architect during shop drawing review, unless otherwise noted.
- D. All diffusers, grilles and registers must be compatible with the designed ceiling/wall type. Refer to architectural drawings for exact details of ceiling/wall construction.

2.2 DIFFUSERS, REGISTERS AND GRILLES SHALL BE OF TYPE AS HEREIN SPECIFIED

Designation	Service	Air Pattern
E	Return/Exhaust	45° Deflection
F	Wire Mesh	---

- A. Type E (Return and Exhaust)
 - 1. General return/exhaust registers shall be similar to Tuttle & Bailey Model T77D and shall be made of steel or aluminum with (1) set of fixed blades, 42° deflection. Provide with countersunk holes and suitable frame to match ceiling or wall construction.
 - 2. All return and exhaust registers installed in all toilet rooms, laundry rooms, showers and other areas subject to moisture shall be similar to above except constructed of all aluminum, equal to Tuttle & Bailey Model A77D.
- B. Type F (Air Screens/Wire Mesh)
 - 1. Mesh shall be 3/4" square pattern, 1/16" galvanized wire, interwoven, welded or secured to frame.
 - 2. Frames shall be 1" by 1" by 1/8" galvanized steel angles for duct sizes through 24"; 1 1/2" x 3/16" for duct sizes between 25" and 48"; and, 2" by 2" by 3/16" for ducts larger than 48", continuous around perimeter of screen.

PART 3 - INSTALLATION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instruction.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry and lighting arrangement.
- C. Install diffusers to ductwork with air tight connections.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION 233700

SECTION 233900 – FANS AND ACCESSORIES
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all fans of the various types, arrangement and sizes specified herein and as scheduled on the drawings.
- B. Fans shall include all motors, drives, curbs, flashing, special coatings and accessories.
- C. Furnish and install automatic dampers with all fans.
- D. Furnish and install all roof curbs and automatic dampers.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as following:
 - 1. AMCA 99 – Standards Handbook; 1986.
 - 2. AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes; 1985.
 - 3. AMCA 261 – Directory of Products Licensed to Bear the AMCA Certified Ratings Seal; 1995.
 - 4. AMCA 300 – Test Code for Sound Rating Air Moving Devices; 1994.
 - 5. AMCA 301 – Method of Publishing Sound Rating Air Moving Devices; 1994.
 - 6. NEMA MG 1 – Motors and Generators; 1993 (and Revision 1).
 - 7. NFPA 96 – Installation of Equipment for the Removal of Smoke and Grease Vapors from Commercial Cooking Equipment; 1994.
 - 8. UL 705 – Power Ventilators; 1994.

1.5 SUBMITTALS

- A. See Section 230500 and General Conditions for additional requirements.
- B. Submit certified curves showing fan performance with system operating points plotted on curves.
- C. Submit motor data sheets including motor efficiency and power factor at various loadings of nameplate horsepower. Motor efficiency and power factor shall be shown for 100%, 75% and 50% of nameplate horsepower. Submit data on efficiency and power factor required for motors 1 HP and above only. Motors shall have premium efficiency motors with minimum efficiency on motors listed in specification.
- D. Submit bearing sizing calculations for each similar size and type of fan. Fan bearing calculations shall be based on fan at maximum operating conditions including belt pull. Calculations shall be done for both fan bearings and motor bearings. Calculations required on centrifugal fans, vent sets in-line fans, wall mounted propeller fans and vane axial fans only.
- E. Submit sound power levels for each size and type of fan. Sound levels shall be in all (8) octave bands for discharge of fan, inlet to fan, and radiated noise through casing.
- F. Submit certified shop drawings indicating all dimensional data, and operating and maintenance clearances.

1.6 QUALITY ASSURANCE

- A. Fans shall conform to most recent AMCA Bulletins regarding construction and testing. Fans shall be tested and rated per AMCA and shall be selected in proper operating range without motor overloading and fan surge.
- B. Manufacturers must prove experience in the production of similar products of this type for at least ten (10) years prior.
- C. Fans shall be air and sound certified in accordance with AMCA 210 and 300 and shall bear the AMCA seal.
- D. Kitchen Range Hood Exhaust Fans: Comply with requirements of NFPA 96.
- E. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. and other testing firm acceptable to the authority having jurisdiction and all suitable for the purpose specified and indicated.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate fans for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings have been lubricated and fan has been test run under observation.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturers acceptable contingent upon product's compliance with the specifications are as follows:
1. In-Line Tubular Centrifugal Fans
 - a. Greenheck Fan Corp.
 - b. Loren Cook Co.
 - c. Buffalo Forge Co.
 - d. New York Blower
 - e. Twin City Fan
- B. Selection and Balancing
1. Provide and install items as listed in equipment schedules, as shown on drawings, and as specified, complete in all respects to the functions intended.
 2. Provide fans capable of accommodating static pressure variations of $\pm 10\%$.
 3. Provide balanced variable sheaves for motors 15 HP and under, and fixed sheaves for 20 HP and over.
 4. Statically and dynamically balance fans in the field to eliminate vibration or noise transmission to occupied areas of the building. Provide certificate of compliance from manufacturer.
 5. Provide OSHA and ANSI approved belt guards on interior mounted belt driven fans. Provide weatherproof ventilated housing for exterior mounted fans.
 6. Provide special construction fans such as sparkproof, explosionproof, or coated fans as required by the schedule.
 7. Provide safety, bird or insect screen where inlet or outlet is exposed.
 8. All fans shall be manufactured in accordance with this specification even where techniques are required which are not considered standard by that manufacturer.

9. Verify fan arrangement with the Contractor including motor location for servicing and discharge arrangements for proper airflow.
10. Where fixed speed sheaves are specified for a particular fan, provide (2) additional sheaves (one motor and one drive) as necessary for final air balancing.
11. All (direct drive) fan shafts (which are connected to a variable speed controller) must be complete with a factory mounted shaft groundingbrush/device.

C. Painting

1. Each fan component shall be thoroughly cleaned, degreased and deburred before the application of a rust preventive primer.
2. Two (2) coats of a rust preventive primer shall be applied under a topcoat of air-dried epoxy or enamel. Minimum coating thickness shall be 5 to 6 mils. The final coat shall be applied after final assembly to all surfaces.
3. Special coatings shall be provided for corrosive exhaust systems as specified under the fan specification.

D. Additional Corrosion Protection

1. Fans serving laboratory fume hoods, or as scheduled on the drawings, shall have all components in contact with the airstream provided with a minimum of (2) coats of 5 mil thick air-dried Heresite VR500 coating.

2.2 IN-LINE TUBULAR CENTRIFUGAL FANS

- A. Provide belt driven centrifugal type in-line fans with capacities as indicated in the equipment schedules on the mechanical drawings.
- B. AMCA pressure Class I or Class II as indicated in the equipment schedule.
- C. Fan housing shall be heavy gauge galvanized steel welded to a rigid galvanized structural steel framework or steel coated with an epoxy finish. Minimum thickness of epoxy finish shall be 5 mils. Fan housing shall be provided with mounting brackets at both inlet and discharge suitable for hanger rods or bolting directly to structure.
- D. Fan housing shall have inlet and outlet connections flanged.
- E. Fan inlet cone shall have a die spun hyperbolic shape and be matched to the wheel cone to ensure full loading of fan blades and to maximize efficiency.

- F. Fan wheel shall have single thickness backward inclined blades or true hollow airfoil shaped blades. Wheel characteristics shall be non-overloading.
- G. Fan inlet cone, wheel cone, blades and backplate shall be constructed of heavy gauge aluminum or steel. Steel construction shall be coated with an epoxy coating having a minimum thickness of 5 mils.
- H. Blades shall be welded to wheel cone and backplate.
- I. Wheel shall be statically and dynamically balanced.
- J. Drive shaft shall be ground and polished high grade steel supported by permanently lubricated sealed ball bearings housed in a cast iron pillow block housing.
- K. Bearings shall be sized for a minimum of L-10 life of 200,000 hours at maximum fan operating conditions including belt pull. Bearings shall be selected in accordance with standards set forth by the Anti-Friction Bearing Mfrs. Assn.
- L. Drives shall be sized for a minimum of 1.65 times the fan motor horsepower. Sheaves shall be adjustable and have a tapered lock, split and keyed hub. Belts shall be oil resistant, 24,000-hour non-static type.
- M. Fan shall be suitable for horizontal or vertical mounting.
- N. Motor, drive, and bearings shall be out of the exhaust airstream and housed to facilitate ease of maintenance. Motor cooling shall be through the fan drive and motor housing. Housing for motor drive and bearings shall be of the same construction as the fan housing.
- O. Motors shall be in accordance with Motors Section of the Special Conditions.
- P. Fans shall be constructed in accordance with AMCA 99-0401 Type A, B or C.
- Q. Provide with 1/2" by 1/2" galvanized wire mesh attached to a galvanized structural steel frame. Frame shall be bolted to the flanged housing construction.
- R. Provide thrust arrestors as required to limit movement of the fan upon start-up.

PART 3 - FAN INSTALLATION REQUIREMENTS

3.1 INSTALLATION

- A. Fans shall be installed in accordance with manufacturer recommendations, Contract Drawings and reviewed submittals.

- B. Fans shall be installed so as to ensure easy accessibility for service or removal or replacement of all components such as, but not limited to, fans, motors, belts, drives, bearings, dampers, actuators, isolators, and field connections.
- C. The HVAC Contractor shall install all motors and drives shipped loose. Fans shall be installed and tested, and shall be made fully operational by the HVAC Contractor.
- D. Provide fixed sheaves as necessary for final air balancing. The Contractor shall install the fixed sheave after balancing with the Contractor to adjust the fans.
- E. Manufacturer shall include the adjustment of pitch for adjustable pitch fans as required by balancing.
- F. Set roof mounted fans on sound absorbing insulated curbs. Coordinate installation with Roofing Contractor. Curbs shall be provided by the HVAC Contractor. The HVAC Contractor shall provide all counter flashing.
- G. Mount vent sets and vane axial fans located on roof to inertia bases as required under Vibration Isolation Section.
- H. Make all penetrations through roof or vertical walls watertight. Submit methods of sealing to Architect/Engineer for review and approval.
- I. All fans shall have flexible inlet and outlet couplings to prevent vibration transmission to ductwork.
- J. The Contractor shall assemble all loose parts including motors and drive assemblies on site and shall vibration balance the fans in the field. Field adjustment including belt alignment, wheel balancing, belt tension, greasing of bearings, installation of belt guards, and other loose parts shall be provided by the HVAC Contractor.

3.2 COORDINATION

- A. The Contractor shall coordinate the fan arrangement with the coordinated ductwork layout prior to ordering the fan. The Contractor shall provide all labor and materials necessary to change fan arrangement in the field when fan arrangement does not match ductwork.
- B. The inlet and discharge ductwork shall have a minimum straight run of (2) fan diameters upstream and downstream of the fan. The Contractor shall notify the Engineer in writing if these conditions cannot be achieved. Installation of improper inlet/discharge conditions without the review of the Engineer shall be corrected in the field at no cost to the Owner.
- C. The discharge duct arrangement shall comply with AMCA recommended layouts for elbows after fans.

- D. The Contractor shall provide all supplemental steel, supports, rods and hangers necessary to hang or mount fans. Supports shall include thrust restraint as required by the fan manufacturer.
- E. The fan manufacturer and Contractor shall coordinate the fan orientation for tubular centrifugal fans and shall verify that the fan support and bearings are supplied for the coordinated fan orientation (horizontal or vertical). The Contractor shall revise the fan in the field if job conditions require changing of orientation, at no cost to the Owner.
- F. The Contractor shall receive and inspect all fans and motors to make sure that all fans are received without defect. All defective or damaged fans shall be returned to the manufacturer by the Contractor for replacement.
- G. The Contractor shall properly protect all equipment to prevent damage from water, dirt, etc. Protection shall include temporary plastic wrap to keep equipment in original factory condition. Fans used for temporary ventilation during construction shall be totally cleaned and refurbished prior to turnover to the Owner.
- H. The HVAC Contractor shall mount and vibration balance all fans. The Electrical Contractor shall furnish and install power wiring to the fan motor and verify proper fan rotation. The HVAC and Electrical Contractors shall coordinate the starter requirements to ensure that the proper starter is installed for non-standard motors. The ATC Contractor shall wire all interlocking wiring to the fan including smoke detector wiring for fan shutdown.
- I. The HVAC Contractor shall mount all automatic control dampers on the fan either shipped loose or provided by the ATC Contractor.
- J. The HVAC Contractor shall mount all field mounted flow measuring devices on the inlet or discharge of the fan prior to fan installation.

END OF SECTION

SECTION 238235 – TERMINAL HEAT TRANSFER UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all terminal heat transfer units of the type, size and capacity as scheduled.
- B. Units shall be UL and AGA listed in accordance with the specific unit's heat transfer design and construction.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as following:
 - 1. UL 1025-89 – Electric Air Heaters.
 - 2. UL 1042-86 – Electric Baseboard Heating Equipment.
 - 3. ASHRAE 90.1 – Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
 - 4. NFPA 54 – National Fuel Gas Code.
 - 5. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.
 - 6. NFPA 90B – Installation of Warm Air Heating and Air Conditioning Systems.

1.5

TERMINAL HEAT TRANSFER UNITS
Project No. 0320-0019

238235-1

1.6 SYSTEM DESCRIPTION

- A. Furnish and install all radiation, unit heaters, radiant panels, controls, piping, wiring, enclosures, access doors, etc. to make a complete and operational system.
- B. All enclosures shall be installed with aligning strips, plaster frames and end trims so as to provide a neat architectural finish.
- C. All equipment shall be new and shall be of the type, style, size and capacities as scheduled. All radiation enclosures shall be continuous and of the same finish and style as adjacent enclosures.

1.7 SUBMITTALS

- A. See Section 230500 and General Conditions for additional requirements.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
 - 1. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers and comparison of specified heat required to actual heat output provided.
 - a. Indicate cross sections of cabinets, grilles, bracing and reinforcing, mounting details and insulation if required and typical elevations.
 - b. Indicate flows, pressure drops (including interconnecting piping for radiant panels), heat outputs and mean temperatures.
 - c. Indicate mechanical and electrical service locations and requirements.
- D. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- E. Project specific installation instructions and details.
- F. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets and ceiling panels required for access or valving.
- G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data and parts listings.

- H. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriter's Laboratories Inc. testing firm acceptable to the authority having jurisdiction and suitable for the purpose specified and indicated.

1.9 PRODUCT, STORAGE AND HANDLING

- A. Delivery of materials shall be made to the project by the materials supplier in accordance with the instructions to the Contractor.
- B. The Contractor shall provide adequate locked storage space with shelving for the materials, shall be responsible for all items of materials after receipt from the supplier, and shall replace all materials lost or damaged after delivery and receipt.
- C. The Contractor shall furnish the materials supplier with receipts for all materials and accessory items received and shall send copies of these receipts to the Architect.

1.10 WARRANTY

- A. See General Conditions for additional warranty requirements.

PART 2 - PRODUCTS

2.1 UNIT HEATERS

- A. General
 - 1. All type heaters, as applicable, shall be hung with vibration spring isolators as hereinbefore specified.
 - 2. The Contractor shall provide control valves and unit or remote mounted thermostats and wire to fan, to cycle fan "on/off."
 - 3. The Contractor shall make provisions to "open/close" the steam or water control valves when heaters are "on/off", as indicated hereinafter.
 - 4. Unit manufacturer shall provide starters and disconnect switches.

5. Thermostats used with all type heaters shall be coordinated with the unit manufacturer for compatibility with equipment.
6. Heater colors, where applicable, shall be as provided as standard by the unit manufacturer.
7. Heater finish color shall be as determined by the Architect during shop drawings from the colors provided as standard by the unit manufacturer.
8. Temperature Control
 - a. Thermostat control shall be provided on floor and wall mounted units, consisting of factory built-in thermostat or wall-mounted thermostat of fully enclosed and snap acting to prevent radio or TV interference. The thermostat shall have a temperature adjustment range between 45°F and 95°F. Integral thermostats shall have tamperproof adjustment through the discharge grille by means of a hex wrench. Ceiling and inverted mounted units shall be provided with wall mounted MHT 4015E-1007 thermostat.
 - b. If not indicated on the plans the unit shall have a unit mounted return airside thermostat.
 - c. Thermostat shall operate the single-phase holding coil circuit of the integrally mounted power control relay(s). This single-phase relay holding coil circuit shall either be powered from the cabinet unit heater main power supply or from a separate 120V or 24V single-phase circuit.
 - d. An integral fan delay switch shall be provided to prevent discharge of cold air, by delaying start-up of the fan motor until heating elements have warmed up. This same fan delay switch shall maintain motor operation after heating elements have been de-energized to dissipate any residual heat.
 - e. Floor, wall and inverted mounted units shall be equipped as standard with a 2-speed/2-heat selector switch which will permit simultaneous tamperproof "high/low" adjustment of fan speed and heat output by means of a hex wrench through the discharge grille. Ceiling mounted units shall be wired for medium speed.

B. Electric propeller type unit heaters shall be as follows:

1. Provide electric unit heaters of the type, size, capacity and voltage as specified on the drawings.

2. Acceptable manufacturers subject to compliance with the specifications shall be as follows:
 - a. Qmark
 - b. Markel
 - c. Chromalox
 - d. Singer
3. Enclosures shall be fabricated from heavy gauge zinc coated steel, finished in high gloss beige enamel. Enclosures shall contain heating elements, contactors and control transformers where required. Air shall be drawn in the back of the heater and discharged through independently adjustable horizontal louvers on the front. In the low portion of the front, a large hinged access door extending the width of the heater shall be provided for easy wiring and inspection of controls. Heater and supply wiring diagram shall be attached permanently to the inside of this door. Motor shall be mounted on a heavy gauge formed wire protective guard. A castle nut with cotter key shall be supplied on the top of the unit at center of gravity to allow easy support and adjustment.
4. Elements shall consist of helically coiled nickel chromium alloy resistance wire embedded and completely surrounded in magnesium oxide, enclosed and swaged into corrosion resistant sheaths to which are permanently attached corrosion resistant steel fins. Element assemblies shall be circular in shape and enclosed in a closely fitting cylinder creating a pressure chamber to assure uniform airflow.
5. Motors shall be totally enclosed industrial rated single-phase, permanently lubricated and equipped with thermal overload protection with automatic reset. Units rated 20 KW and less shall have shaded pole motors. Those over 20 KW shall have permanent split capacitor motors.
6. Fan blade shall be of the axial flow type designed for high efficiency and quiet operation. Fan speed shall not exceed 1700 rpm.
7. All heaters shall be equipped with a manual reset thermal cutout which disconnects elements and motors in the event normal operating temperatures are exceeded.
8. Heaters shall be designed for a single supply circuit, with elements, motor and control circuits subdivided and fused to conform to the National Electric Code, Occupational Safety and Health Act (OSHA) and Underwriters' Laboratories, Inc., Standard 573-1968. All 3-phase heaters shall have balanced phases.

9. Contactors and control circuit transformers, where required, shall be factory assembled and wired with only direct line supply and thermostat connections required in the field.
10. Heaters are to be listed under the Re-Examination Service of Underwriters' Laboratories, Inc. Heaters shall be guaranteed to be free from defective material and workmanship for a period of one (1) year, with the exception of the heating elements which shall be guaranteed for five (5) years.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install equipment exposed to finished area after walls and ceiling are finished and painted. Do not damage equipment or finishes.
- C. Protection: Provide finished cabinet units with protective covers during balance of construction.
- D. Unit Heaters: Hang from building structure and not from piping, with gas pipe hangers anchored. Mounts as high as possible to maintain greatest headroom unless otherwise indicated.
- E. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals and Section 260520.

3.2 CLEANING

- A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
- C. Install new filters at all cabinet unit heaters prior to completion of the project.

END OF SECTION 238235

SECTION 238240 - DX MINI-SPLITS SYSTEM
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all terminal heat transfer units of the type, size and capacity as scheduled.
- B. Units shall be UL and AGA listed in accordance with the specific unit's heat transfer design and construction.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as following:
 - 1. UL 1025-89 – Electric Air Heaters.
 - 2. UL 1042-86 – Electric Baseboard Heating Equipment.
 - 3. ASHRAE 90.1 – Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
 - 4. NFPA 54 – National Fuel Gas Code.
 - 5. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.

6. NFPA 90B – Installation of Warm Air Heating and Air Conditioning Systems.
7. NFPA 211 – Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances.

1.5 SYSTEM DESCRIPTION

- A. Furnish and install all radiation, unit heaters, radiant panels, controls, piping, wiring, enclosures, access doors, etc. to make a complete and operational system.
- B. All enclosures shall be installed with aligning strips, plaster frames and end trims so as to provide a neat architectural finish.
- C. All equipment shall be new and shall be of the type, style, size and capacities as scheduled. All radiation enclosures shall be continuous and of the same finish and style as adjacent enclosures.

1.6 SUBMITTALS

- A. See Section 230500 and General Conditions for additional requirements.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
 1. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers and comparison of specified heat required to actual heat output provided.
 - a. Indicate cross sections of cabinets, grilles, bracing and reinforcing, mounting details and insulation if required and typical elevations.
 - b. Indicate flows, pressure drops (including interconnecting piping for radiant panels), heat outputs and mean temperatures.
 - c. Indicate mechanical and electrical service locations and requirements.
- D. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- E. Project specific installation instructions and details.

- F. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets and ceiling panels required for access or valving.
- G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data and parts listings.
- H. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriter's Laboratories Inc. testing firm acceptable to the authority having jurisdiction and suitable for the purpose specified and indicated.

1.8 PRODUCT, STORAGE AND HANDLING

- A. Delivery of materials shall be made to the project by the materials supplier in accordance with the instructions to the Contractor.
- B. The Contractor shall provide adequate locked storage space with shelving for the materials, shall be responsible for all items of materials after receipt from the supplier, and shall replace all materials lost or damaged after delivery and receipt.
- C. The Contractor shall furnish the materials supplier with receipts for all materials and accessory items received and shall send copies of these receipts to the Architect.

1.9 WARRANTY

- A. See General Conditions for additional warranty requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Mitsubishi-Multi City (4 Ton – PUMY-P48NHMU-S-Series)

2.2 SYSTEM DESCRIPTION

- A. The heat pump air conditioning system shall be similar to a Mitsubishi Electric (Variable Refrigerant Flow Zoning) System.

2.3 QUALITY ASSURANCE

- A. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

2.4 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendation.

2.5 WARRANTY

- A. The units shall be covered by the manufacturer's limited warranty for a period of three (3) year from date of installation.

2.6 MULTI-SPLIT INVERTER HEAT PUMP

- A. The heat pump air conditioning system shall be a Mitsubishi Electric PUMY variable capacity multi-zone series. The system shall consist of two (2), three (3), or four (4) slim silhouette, compact, wall mounted indoor fan coil sections with digital wireless remote controller and a slim silhouette horizontal discharge outdoor unit which shall be of an inverter driven heat pump design.
- B. Indoor unit model numbers may be MSZA09NA, MSZA12NA, MSZA15NA, MSZA17NA and MSZA24NA. Outdoor unit model numbers may be MXZ2A20NA (1:1 or 2:1), MXZ3A30NA (2:1 or 3:1), and MXZ4A36NA (3:1 or 4:1) multi-zone systems.
- C. SPLIT-S The units shall have a manufacturer's parts and defects warranty for a period one (1) year from date of installation. The compressor shall have an extended warranty of 6 years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty will not include labor.
- D. Manufacturer shall have over 25 years of continuous experience in the U.S. market.
- E. Each system shall perform in accordance with the ratings shown in the schedules.

- F. Cooling performance shall be based on 80°F DB, 67°F WB for the indoor unit and 95°F DB, 75°F WB for the outdoor unit at rated frequency: A09-50Hz, A12-76Hz, A15-77Hz, A17-79Hz, A24-110Hz.
- G. Heating performance shall be based on 70°F DB, 60 °F WB (, 15.6°C WB) for the indoor unit and 47 ° F DB, 43° F WB for the outdoor unit at rated frequency: A09-61Hz, A12-76Hz, A15-78Hz, A17-88Hz, A24-101Hz.YSTEM
- H. Indoor Unit
1. General:
 - a. The indoor unit shall be fully factory assembled, wired and run tested prior to shipment. Contained within the indoor unit shall be all factory wiring, piping, control circuit board, fan, and fan motor. The unit shall have a self-diagnostic function, 3-minute restart time delay mechanism, an auto restart function, an emergency / test operation. Indoor unit shall be charged with dry air before shipment from factory.
 2. Unit Cabinet:
 - a. The casing shall have a white finish.
 - b. Multi directional drain and refrigerant piping, offering three (3) direction pipe alignment for all refrigerant piping and two (2) direction pipe alignment for condensate draining shall be standard.
 - c. There shall be a separate back plate that secures the indoor unit firmly to the wall.
 3. Fan:
 - a. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor.
 - b. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearing.
 - c. A manual adjustable guide vane shall be provided with the ability to change the horizontal airflow from side to side (left to right).
 - d. An integral, motorized, multi-position, vertical air sweep flow louver shall provide for uniform air distribution. Louver position shall be selectable from the remote controller
 - e. The indoor fan motor shall be capable of three (3) speed operation: High, Medium and Low.

I. Filter:

1. Return air shall be filtered by means of an easily removed, washable, Catechin, Antioxidant Pre-filter and a separate Anti-allergy enzyme filter – blue bellows type.

J. Coil:

1. The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The refrigerant tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phosphor copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.

K. Electrical:

1. The indoor unit electrical power shall be 208 / 230 volts, 1-phase, 60 hertz.
2. The system shall be equipped with A-Control – a system allowing each indoor unit to be powered and controlled directly from the outdoor unit using a 14 gauge (AWG) 3-wire connection plus ground providing both primary power and integrated, bi-directional, digital control signal without additional connections.
3. The indoor units shall not have any supplemental or “back-up” electrical heating elements.

L. Control:

1. Each indoor unit shall be provided with a digital, wireless, remote controller to perform all input functions necessary to operate the system.
2. The remote controller shall provide a Power On/Off switch, Mode Selector – Cool-Dry-Heat, Temperature Setting, 24 Hour Clock / Timer Control, Fan Speed Select and Auto Vane selector.
3. Operating mode for all units in the multi-zone system shall be determined by the first indoor unit to request Heat or Cool function.
4. The indoor unit shall perform Self-diagnostic Function and be equipped with Test Run switching and Check Mode switching.

5. Temperature changes shall be by 1°F increments with a range of 61-88°F.
6. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wireless or wired digital remote controller, providing emergency operation and controlling the outdoor unit.
7. The indoor units shall be capable of working with both single-zone or multi-zone outdoor units
8. The system shall be capable of automatically restarting, at all previous settings, when the power is restored after power interruption.
9. The digital remote controller shall control the operation of the motorized, vertical, air sweep louver for Auto (position determined by control program), Manual (four controller selectable positions) or Sweep (continuous motion). The louver shall drive to the closed position when the indoor unit is turned off.

M. Outdoor Units:

1. The M-NET outdoor units shall be specifically designed to work with the M-NET family of indoor units. The units must have a fused powder coated finish in a Munsell 5Y 8/1 color. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory prior to shipment.

a. Unit Cabinet:

- 1) All casing and cabinet components shall be fabricated of galvanized steel, bonderized finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for durable, corrosion resistant surface protection.

b. Fan:

- 1) The unit shall be furnished with a direct drive, high performance propeller type fan.
- 2) The condenser fan motor shall be a variable speed, direct current (DC) motor and shall have permanently lubricated bearings.
- 3) Fan speed shall be switch automatically according to the number of operating indoor units and the compressor operating frequency.

- 4) The fan motor shall be mounted with vibration isolation for quiet operation.
- 5) The fan shall be provided with a raised guard to prevent contact with moving parts.
- 6) The outdoor unit shall have horizontal discharge airflow.

c. Coil:

- 1) The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
- 2) The coil shall be protected with an integral guard.
- 3) Refrigerant flow from the outdoor unit shall be independently controlled by means of individual electronic linear expansion valves for each indoor unit.

d. Compressor:

- 1) The compressor motor shall be direct current (DC) type designed for variable speed operation.
- 2) The compressor shall be a high performance, hermetic, inverter driven, variable speed, rotary type.
- 3) The outdoor unit shall be equipped with a suction side refrigerant accumulator.
- 4) The compressor will be equipped with an internal thermal overload.
- 5) The compressor shall be mounted to avoid the transmission of vibration.

N. Piping Requirements:

1. The outdoor unit must have the ability to operate within the following refrigerant piping and height limitations without the need for line size changes, traps or additional oil.

O. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

2. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.
3. The outdoor unit shall be controlled by the microprocessors located in the indoor unit and in the outdoor unit communicating system status, operation, and instructions digitally over A-Control wiring.
4. The outdoor unit shall be equipped with Pulse Amplitude Modulation (PAM) compressor inverter drive control for maximum efficiency with minimum power consumption.

2.7 SPLIT-SYSTEM

- A. The Air Conditioner system shall be a Mitsubishi Electric split system with Variable Speed Inverter Compressor technology. The system shall consist of a ceiling cassette indoor section that shall include a four (4) way grill with integral return and be equipped with a wired, wall mounted, remote controller and a matched capacity, horizontal discharge, single phase outdoor unit.
- B. The units shall have a manufacturer's parts and defects warranty for a period one (1) year from date of installation. The compressor shall have a warranty of 6 years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.
- C. Manufacturer shall have over 25 years of continuous experience in the U.S. market.
- D. Each system shall perform in accordance to the ratings shown in the table below. Cooling performance shall be based on 80°F DB, 67°F WB (26.7°C DB, 19.4°C WB) for the indoor unit and 95°F DB, 75°F WB (35°C DB, 29.3°C WB) for the outdoor unit.
- E. Indoor Unit
 1. Cabinet
 - a. The indoor unit cabinet shall be a space-saving ceiling-recessed cassette type, The cabinet shall be formed from galvanized sheet metal coated with high-density foam insulation.
 - b. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, condensate lift mechanism, control circuit board, fan, and fan motor. Single branch ducting shall be allowed from cabinet. The cabinet panel shall have provisions for a field installed filtered outside air intake.

- c. A separate grill assembly shall be attached to the front of the cabinet to provide supply air vanes in four directions and a center mounted return air section. The four-way grill shall be fixed to bottom of cabinet allowing two, three or four-way blow. The grill vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space. Grill assembly color shall be Munsell 6.4Y 8.9/0.4
 - d. The unit, in conjunction with the wired, wall-mounted controller shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and integral refrigerant pipes shall be purged with dry nitrogen and capped before shipment from the factory.
2. Fan
- a. The indoor fan shall be an assembly with a turbo fan propeller, direct driven by a single motor and shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
 - b. The indoor fan shall consist of five (5) speed settings, Low, Mid1, Mid2, High and Auto. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
3. Vane
- a. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow with switches that can be set to provide optimum airflow based on ceiling height and number of outlets used.
 - b. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
 - c. If specified, the grill shall have an optional i-see® sensor that will measure room temperature variations and adjust the airflow accordingly to evenly condition the space.
4. Filter
- a. Return air shall be filtered by means of an easily removable, long life, washable filter.
5. Coil

- a. The indoor unit coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange.
- b. The heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory.
- c. A condensate pan with drain connections shall be provided under the coil. The unit shall also include a built-in, automatic condensate lift mechanism that will be able to raise drain water 33 inches (84 cm) above the condensate pan. The lift mechanism shall be equipped with a positive acting liquid level sensor to shut down the indoor unit if liquid level in the drain pan reached maximum level.
- d. Both refrigerant lines between the indoor unit and outdoor unit shall be fully insulated.

6. Electrical

- a. The electrical power of the unit shall be 208 / 230 volts, 1-phase, 60 hertz.
- b. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.
- c. The indoor unit shall be provided with A-Control – a system allowing the indoor unit to be powered and controlled directly from the outdoor unit using a 14 gauge (AWG) 3-wire connection plus ground providing both primary power and integrated, bi-directional, digital control signal without additional connections.
- d. The indoor units shall not have any supplemental or “back-up” electrical heating elements.

F. Control

- 1. The control system shall consist of two (2) microprocessors, one in each indoor and outdoor unit, interconnected by A-Control. This three (3) conductor 14 ga. AWG wire with ground method shall provide power feed and bi-directional digital control transmission between the outdoor and indoor units.
- 2. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability,

including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller display panel.

3. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and for controlling the operation of the outdoor unit.
4. Replace the wired controller with a wireless receiver PAR-SA9FA-E and provide wireless controller PAR-FA32MA-E
5. A two wire (one pair) twisted, stranded, 18 gauge (AWG), jacketed, control cable shall be used to connect the controller to the indoor unit.

G. Outdoor Unit

1. The outdoor unit shall be compatible with the three different types of indoor units (PKA - wall mounted). The connected indoor unit must be of the same capacity as the outdoor unit.

Option: Twinning is allowed as described in 6.02 below.

2. Models PUY-A24NHA and PUY-A36NHA shall have the option to connect to two indoor units, within the same confined space, to improve air distribution (total capacity shall be equivalent to outdoor unit). This is described as Twinning – a single wired wall mounted remote controller must control both indoor units simultaneously.
3. The outdoor unit shall be equipped with a control board that interfaces with the indoor unit to perform all necessary operation functions.
4. The outdoor unit shall be capable of operating at 0°F ambient temperature without additional low ambient controls (optional wind baffle shall be required). The outdoor unit shall be able to operate with a maximum height difference of 100 feet (30 meters) between indoor and outdoor units.
5. System shall have a maximum refrigerant tubing length of 100 feet (30 meters) for the 12,000 and 18,000 and 165 feet (50 meters) for the 24,000, 30,000, 36,000, and 42,000 BTU/h units between indoor and outdoor units without the need for line size changes, traps or additional oil.
6. Models PUY-A12NHA PUY-A18NHA PUY-A24NHA, PUY-A30NHA and PUY-A36NHA shall be pre-charged for a maximum of 70 feet (20 meters) of refrigerant tubing. – the PUY-A42NHA shall be pre-charged for a maximum of 100 feet (30 meters) of refrigerant tubing

7. The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.

H. Cabinet

1. The casing shall be constructed from galvanized steel plate, coated with a finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a munsell 3Y 7.8/1.1 finish. The fan grill shall be of ABS plastic.

I. Fan

1. Models PUY-A12NHA PUY-A18NHA, PUY-A24NHA, PUY-A30NHA, and PUY-A36NHA shall be furnished with an AC fan motor. Model PUY-A42NHA shall have two (2) DC fan motors
2. The fan motor shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent contact with moving parts.

J. Coil

1. The L shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be control by a microprocessor controlled step motor.

K. Compressor

1. The compressor for models PUY-A12NHA PUY-A18NHA, PUY-A24NHA, PUY-A30NHA and PUY-A36NHA shall be a DC rotary compressor with Variable Compressor Speed Inverter Technology.
2. The compressor for model PUY-A42NHA shall be a frame compliant scroll compressor with Variable Speed Inverter Technology
3. All compressors shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the zone space load for significantly increasing the efficiency of the system which results in vast energy savings. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be intermittently applied to the compressor motor to maintain sufficient heat.

4. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

L. Electrical

1. The electrical power of the unit shall be 208volts or 230 volts, 1 phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The outdoor unit shall be controlled by the microprocessor located in the indoor unit.
2. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.

END OF SECTION 238240

SECTION 260500 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 APPLICATION

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.
- C. This Section applies to all sections of Division 26 of this Contract, except if specified otherwise in the individual section.
- D. Electrical work, equipment and material shall be only that suitable for a commuter railroad station and shall be of the highest class, and shall be applied in the best manner and according to the best rules and usages of electric work. Where no specific requirements are given, the work and materials shall conform to the latest applicable standards of material and construction of nationally recognized associations.

1.2 SUBMITTALS

- A. Submit the following in accordance with Standard Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. In accordance with the General and Special Conditions, specific items requiring submittals are specified in each individual section of Division 26. Shop drawings shall be submitted for review before procurement, fabrication, or delivery of such items to the jobsite. Partial submittals are not acceptable; such submittals will be returned without review.
- C. Manufacturer's Data: Submittals for each manufactured item shall be manufacturer's descriptive literature, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Each submittal shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, specification reference, applicable Federal and industry specification references, and all other information necessary to establish Contract compliance.

- E. Shop Drawings shall show types, sizes, accessories, elevations, floor plans, sectional views, installation details, elementary diagrams, and interconnection wiring diagrams. Wiring diagrams shall identify circuit terminals and shall indicate the internal wiring for each item of equipment and the interconnection between the items both internal and external. Point to point wiring diagrams are required. Elementary wiring diagrams shall contain a sequence of equipment operation.
- F. Contractor shall submit conduit routing drawings and station composite drawings detailing electrical equipment installation layouts for approval by Connecticut DOT/Amtrak prior to performing construction work. Drawings shall also indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If any equipment is nonconforming, the drawings shall be revised to show acceptable equipment and be resubmitted.
- G. Contractor shall submit arc flash analysis and coordination studies after the final equipment has been selected.
- E. Standards Compliance: When materials or equipment are required to conform to the standards or organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturer's Association (NEMA), or Underwriters Laboratories (UL), proof of such conformance shall be submitted to the Engineer for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization competent to perform acceptable tests and approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods, and that the item conforms to the specified organization's standard. For materials and equipment whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of compliance, a certificate of compliance from the manufacturer shall be submitted for approval. The certificate shall identify the manufacturer, the product, and the referenced standard and shall state that the manufacturer certifies that the product conforms to all requirements of the project specification and of the referenced standards listed.
- F. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in the individual sections shall be submitted for approval.
- G. Operation and Maintenance Manual: Submit where necessary conform to the requirements of Standard Form 817.

1.3 POSTED OPERATING INSTRUCTIONS

- A. Operating instructions approved by Connecticut DOT/Amtrak shall be provided for each system and each principal piece of equipment for the use of operation and

maintenance personnel. The operating instructions shall include wiring and control diagrams showing the complete layout of the entire system, including equipment, devices, and control sequence. Operating instructions shall be printed or engraved and shall be framed under glass or in approved laminated plastic and posted where directed by the Engineer. Operating instructions shall be attached to or posted adjacent to each principal piece of equipment and shall include such instructions as startup, proper adjustment, operating lubrication, shutdown, safety precautions, procedure in the event of equipment failure, and any other necessary items of instruction as recommended by the manufacturer of the unit. Operating instructions exposed to the weather shall be made of weather-resisting materials or shall be suitably enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.4 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.5 DELIVERY AND STORAGE

- B. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.
- C. Equipment and materials shall be properly stored, adequately protected and carefully handled to prevent damage before and during installation. Equipment and materials shall be handled, stored, and protected in accordance with the manufacturer's recommendations and as approved by the Engineer. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Outdoor storage of cable will not be permitted. Damaged or defective items, in the opinion of the Engineer, shall be replaced with new items at no additional cost to Amtrak.

1.6 CATALOGED PRODUCTS

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Materials and equipment shall be the cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturer's latest standard design that complies with the specification requirements. When two or more units of the same type, class, and size of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the products of the same manufacturer. Each major component of equipment shall have the manufacturer's

name, address and the model and serial number on a nameplate securely affixed in a conspicuous place, the nameplate of the distributing agent will not be acceptable.

1.7 MANUFACTURER'S RECOMMENDATIONS

- A. Where installation procedures are specified to comply with the recommendations of the manufacturer of the material or equipment being installed, printed copies of these recommendations shall be furnished to the Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

1.8 MECHANICAL REQUIREMENTS

- A. The interconnecting power wiring and conduit, control wiring and conduit as indicated on the drawings, and the electrical power circuits are included under this division. The electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, float or pressure switches, solenoid valves, and other devices functioning to control mechanical equipment, and control wiring and conduit not indicated on the drawings are specified in the appropriate sections covering such work rather than in Division 26.

1.9 COORDINATION

- A. Electrical work shall be coordinated with other trades involved in the construction project. All work shall be carefully laid out in advance, coordinating electrical features with architectural, structural, and mechanical features of construction.

1.10 COORDINATION WITH UTILITIES AND CONNECTICUT DOT/AMTRAK

- A. Contractor shall comply with all local power company requirements.
- B. Contractor shall contact the local telephone company and arrange for installation of telephone equipment.

1.11 CODES, LISTINGS AND STANDARDS

- A. Electrical Codes: All electrical work covered by the Contract Documents shall conform to the requirements of National Electrical Code, 2017 Edition, and all other state and local codes as required.

- B. Listings: All equipment and materials for which Underwriters Laboratories, Inc. (UL) provides product listing service shall be Underwriters Laboratories approved and bear the UL Label.
- C. Equipment and materials wherever applicable shall conform to the following standards:
 - 1. Illuminating Engineering Society (IES).
 - 2. National Electrical Manufacturers Association (NEMA).
 - 3. Institute of Electrical and Electronic Engineers (IEEE).
 - 4. American National Standards Institute (ANSI).
 - 5. Insulated Cable Engineers Association (ICEA).

1.12 ENCLOSURES

- A. Furnish NEMA enclosures to suit location classification, unless otherwise shown on the drawings. The platform area shall be considered NEMA 4X utilizing stainless steel covers and PVC coated boxes and fittings.

1.13 POWER SUPPLY

- A. Power will be obtained from the three phase, four wire, 60 hertz, 480/277 V service available at the main switch installed as part of a prior contract.

1.15 PERMANENT ELECTRIC POWER SERVICE & EQUIPMENT

- A. Not part of this contract
- B. Contractor will verify the presence and suitability of an existing service comprised of utility transformer, main switchboard and grounding, provided as part of a different contract.
- C. Any code and standards deviations observed will be brought to the Engineer's attention.

1.16 GROUNDING

- A. Per plans and Specification 260526. No ground connections to the track rails or to the neutral conductor of the utility feeder will be permitted.

1.17 LIGHTING FIXTURES

- A. The Contractor shall not proceed with the manufacture or installation of any lighting fixtures before approval of the Engineer is obtained.
- B. The Contractor shall submit engineering data for the lighting fixtures to be installed under this Contract as specified in Section 265600.

1.18 SAMPLES OF ELECTRICAL EQUIPMENT

- A. The Contractor shall submit samples of conduits, boxes, fixtures, wiring and other equipment for approval before proceeding with the electrical work.

1.19 SPECIAL REQUIREMENT FOR APPROVAL OF "OR EQUAL" ELECTRICAL DEVICES

- A. The electrical distribution system as specified and shown on the Contract Drawings has been designed to provide system protection and selectivity on inrush, starting, normal overcurrent and ground fault conditions. Any request to install devices other than those specified and shown on the Contract Drawings shall include sufficient information to determine their equality with the devices specified. This information shall include, but not be limited to, the following:
 - 1. For fuses and circuit breakers, time-current curves for the proposed devices comparing them to the devices specified and shown on the Contract Drawings. Manufacturer's curves shall be considered acceptable for this purpose of system protection and selectivity.
 - 2. For transformers, the percent impedance and X/R ratio as supplied by the proposed manufacturer shall be considered acceptable for this purpose of system protection.
 - 3. In addition, the Contractor is required to provide a complete system coordination study and arc flash analysis to show equality of the proposed devices, prior to their approval.

1.20 EXISTING CONDITIONS AND RELOCATIONS

- A. The Contractor, before submitting his proposal, shall visit the site and shall be responsible for having ascertained local conditions, such as location, accessibility and general character of the site, the character and extent of any existing work within or adjacent to the site, and any other work being performed on the site at the time of submitting his proposal. The Contractor shall fully examine all the drawings relating to the work and shall become completely informed as to the extent and character of the work required and prevailing existing conditions. No allowances will be made for the Contractor's failure to avail himself of such information.

1.21 LOCATIONS - APPROXIMATE

- A. The locations of equipment, boxes, switches, outlets, and similar items as shown on the Contract Drawings are approximate only, exact locations shall be determined in the field by the Contractor. In case of interference with other work or of erroneous locations with respect to equipment or structures the Contractor shall furnish all labor and materials to complete the work in an approved manner, at no additional cost to Connecticut DOT/Amtrak.

1.22 DRAWINGS - DIAGRAMMATIC

- A. Conduits and wiring are shown diagrammatically only and, in some cases, only homeruns are shown. Contractor shall furnish, install, and place in satisfactory condition ready for operation, all conduits, cables, and all other material needed for lighting, power, snow melt and other systems shown or indicated in the Contract Documents. Additional conduits and the required wiring shall be installed by the Contractor wherever needed to complete the installation of the specific equipment furnished and to meet NEC requirements at no additional cost to the Connecticut DOT/Amtrak.

1.23 PAINTING

- A. All shop painting shall be accomplished at the manufacturer facilities meeting ANSI standards and shall be included in the bid price for equipment and materials furnished under this division. All scratched or base surfaces of factory painted equipment shall be touched up with the same color paints as used originally.

1.24 CLOSEOUT PROCEDURES

- A. General coordination is required. Closeout procedures shall be sequenced properly so that work will not be endangered or damaged, and that every required performance will be fully tested and demonstrated.
- B. System performance test runs are required. Test runs of electrical systems shall be coordinated with test runs of equipment served.
- C. During test runs, the Contractor shall make final corrections or adjustments of systems to refine and improve performances where possible, including noise and vibration reductions, elimination of hazards, better response of controls, signals and alarms, and similar system performance improvements.
- D. Cleaning and lubrication is required. After final performance test run of each electrical system, the Contractor shall clean system both externally and internally and shall comply with manufacturer's instructions for lubrication. Contractor shall remove excess lubrication, touch up minor damage to factory-painted finishes.

1.25 DOCUMENTATION PROCEDURES

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.
- B. Signed commitments are required. The transfer of the electrical system to Connecticut DOT/Amtrak for operation will not proceed until guarantees, warranties, performance certifications, maintenance agreements and similar commitments to be signed by Contractor and other entities have been executed and transmitted to Connecticut DOT/Amtrak for placement in records.

1.26 GUARANTEE

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. The Contractor shall guarantee and service the entire installation for a period of one (1) year from the date of the final acceptance of the installation by Connecticut DOT/Amtrak.
- C. The Contractor shall, during the period of the guarantee, replace or repair at his own expense any piece of equipment and/or material which is found to be defective. The replacement or repair shall be done as soon as notified by Connecticut DOT/Amtrak or its authorized representative. The Contractor shall also repair all damage to surrounding work caused by the failure, repair or replacement of the defective equipment or material.

1.27 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall furnish and install all electrical equipment, materials and also labor, machinery, tools, transportation, procurement of all necessary permits, certificates and other incidental services, whether described in these specifications and drawings or not, to provide a satisfactory operating electrical installation.
- B. The Contractor shall familiarize himself with the installation requirements of the local electrical utilities and shall furnish and install the equipment in complete accordance therewith.
- C. Contractor shall perform all operations necessary to install, adjust and put into satisfactory operation all electrical equipment.
- D. Contractor shall provide and install conduits, cable and electrical connections, adjustments, and testing of mechanical equipment that requires electrical power.

- E. Contractor shall install UL Listed firestop material on all rated walls per Specification 230584 “Through-penetration firestop systems”.
- F. Providing and installing all required systems and equipment grounding as required to properly ground all system equipment in conformance with the latest requirements of the NEC and best modern practice.
- G. The specifications and Contract Drawings are complimentary; items shown in one, but not in the other shall be as binding as if included in both. Where there is a discrepancy, the Contractor shall assume the most expensive material and/or method of installation for bidding purposes and refer the discrepancy to the Engineer for a decision.

1.28 RECORD DRAWINGS

- A. Refer to Form 817 for as-built documents
- B. The Contractor shall furnish to the Engineer two (2) CD’s of record drawings in MicroStation format and two (2) sets of black-on-white prints, satisfactory to Connecticut DOT/Amtrak, of all electrical equipment installed under this Contract, showing:

1. Electrical equipment as finally installed.
2. The Contractor's approved working drawings.
3. The Manufacturer's name and address.

These reproductions and black-on-white prints shall be 26 inches by 32 inches.

- C. Drawings:
 1. Individual detail wiring drawings shall be furnished showing all connections to all equipment in the final systems furnished or modified under this contract, and drawings showing cable and conduit runs as installed.
 2. Final as-built layout drawings of field equipment, for the various types of installations, shall be furnished by the Contractor.
- D. Before field installation work shall commence, the Contractor shall submit for approval the drawings that he is required to furnish as specified elsewhere herein.
- E. There shall be no substantial completion until all final drawings and manuals have been received by Connecticut DOT/Amtrak.
- F. There shall be no final acceptance of contract until all final drawings and manuals have been received by Connecticut DOT/Amtrak.

- G. The guarantee shall not start until all final drawings and manuals have been delivered to Connecticut DOT/Amtrak.
- H. The Contractor shall be responsible for and shall correct all wiring diagrams of telephone terminal boxes.
- I. All manuals provided by the Contractor shall be originals. Copies of original manuals will not be acceptable.

1.29 CLEAN UP

- A. The Contractor shall execute cleaning, during progress of the Work, including periods when Work is suspended and at completion of the Work.
- B. Requirements of Regulatory Agencies:
 - 1. In addition to the requirements herein, maintain the cleanliness of the Work and surrounding premises within the Work limits so as to comply with federal and local fire and safety laws, ordinances, codes and regulations.
 - 2. Comply with all federal and local anti-pollution laws, ordinances, codes and regulations when disposing of waste materials, debris and rubbish.
- C. The Contractor shall schedule cleaning and disposal operations:
 - 1. So that dust, wash water or other contaminants generated during such operations do not damage or mar painted or finished surfaces.
 - 2. To prevent accumulation of dust, dirt, debris, rubbish and waste materials on or within the Work or on the premises surrounding the Work.
- D. Waste Material Disposal:
 - 1. Dispose of all waste materials, surplus materials, debris and rubbish off the Project site.
 - 2. Do not burn or bury rubbish and waste materials on the Project site.
 - 3. Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
 - 4. Do not discharge wastes into streams or waterways.
- E. Cleaning Materials:

1. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
 2. Use each type of cleaning material on only those surfaces recommended by the cleaning material manufacturer.
 3. Use only materials which will not create hazards to health or property.
- F. During Construction:
1. Keep the Work and surrounding premises within work limits free of accumulations of dirt, dust, waste materials, debris and rubbish.
 2. Keep dust generating areas wetted down.
 3. Provide suitable containers for storage of waste materials, debris and rubbish until time of disposal.
 4. Dispose of waste, debris and rubbish off site at legal disposal areas.
- G. When the Project is completed, the Contractor shall:
1. Remove and dispose of all excess or waste materials, debris, rubbish, and temporary facilities from the site, structures and all facilities.
 2. Repair pavement, roads, sod, and all other areas affected by construction operations and restore them to original condition or to minimum condition specified.
 3. Remove spatter, grease, stains, fingerprints, dirt, dust, labels, tags, packing materials and other foreign items or substances from interior and exterior surfaces, equipment, signs and lettering.
 4. Repair, patch and touch-up chipped, scratched, dented or otherwise marred surfaces to match specified finish.
 5. Remove paint, clean and restore all equipment and material nameplates, labels and other identification markings.
 6. Clean all floors, slabs, pavements, and ground surfaces.
 7. Maintain cleaning until acceptance and occupation by Connecticut DOT/Amtrak.

PART 2 - PRODUCTS

Not Used.
PART 3 - EXECUTION

Not Used.

END OF SECTION 260500

SECTION 260519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 INFORMATION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.2 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.
- C. Section includes wires and cables and wiring connectors and connections.
- D. Related Sections:
 - 1. Section 260553 - Identification for Electrical Systems
 - 2. Section 260533 – Raceway and Boxes for Electrical Systems.
- E. The Contractor shall supply, install, test and commission into service, all conductors indicated on the drawings.

1.3 REFERENCES

- A. National Fire Protection Association (NFPA), including the National Electrical Code (NFPA 70/2017) and NFPA 130/2017
- B. American National Standards Institute (ANSI).

- C. Institute of Electrical and Electronics Engineers (IEEE).
- D. Underwriters Laboratories Inc. (UL).
- E. National Electrical Manufacturers Association (NEMA).
- F. Insulated Cable Engineers Association (ICEA).

1.4 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 1. All wire and cable shall have copper conductors except where indicated otherwise. Copper wires shall be soft drawn, annealed, 98 percent conductivity.
 2. Stranded conductor for feeders and branch circuits.
 3. Conductor not smaller than 10 AWG for power and lighting circuits.
- B. Wiring Methods: Provide the following wiring methods:
 1. Concealed Dry Interior Locations: Use only XHHW-2 insulation, in raceway.
 2. Exposed Dry Interior Locations: Use only XHHW-2 insulation, in raceway.
 3. Wet or Damp Interior/Exterior Locations: Use only XHHW-2 insulation, in raceway.

1.5 DESIGN REQUIREMENTS

- A. Conductor sizes are based on copper.

1.6 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data, Submittal Requirements:
Before installation of wires and cables, submit the following information for each type and size of wire and cable:
 1. Manufacturer of wire and cable, and certificate of compliance;
 2. Number and size of strands composing each conductor;
 3. Conductor insulation composition type in accordance with National Electrical Code and thickness in mils;
 4. Average overall diameter of finished wire and cable;
 5. Minimum insulation resistance in megohms per 1000 feet at 30 degrees C ambient;
 6. Jacket composition and thickness in mils;
 7. Total number of conductors per cable;

8. Shield material (if any) and thickness;

1.7 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.8 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.10 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

1.11 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.12 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown the contractor shall determine routing and lengths required.
- B. Wire and cable routing indicated is approximate and shall be recalculated by contractor.

PART 2 PRODUCTS

2.1 WIRES

- A. Manufacturers:
1. American Insulated Wire Corporation.
 - Or
 2. Approved equal
- B. Product Description: Single conductor 600 volt insulated wire.

- C. Conductor: Compressed concentric stranded copper. The connection lug shall be adequately sized for compressed cables.
- D. Insulation: Type XHHW-2 insulation conforming to UL 44 for feeders and branch circuits.

2.2 WIRING CONNECTORS

- A. Insulated Spring Wire Connectors: Buchanan Construction Products or approved equal.
- B. Insulated Crimp Connectors: Buchanan Construction Products or approved equal.
- C. Uninsulated Crimp Connectors: Burndy Corp. Hydent or approved equal.
- D. Wireway Taps: O-Z/Gedney Co. PMX or PT, with covers PMXC or PTC, or approved equal.
- E. Terminals: Burndy Corp. Nylon insulated terminals or approved equal.
- F. Lugs: Burndy Corp. or approved equal.
- G. Rubber Electrical Tape: 3M or approved equal.
- H. Color Coding Tape: 3M or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify interiors have been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.
- B. Transmit submittals required by this Section.
- C. Furnish products as indicated.

3.3 EXISTING WORK

- A. Not applicable

3.4 INSTALLATION

- A. Route wire and cable to meet project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panel boards.
- C. Identify wire and cable under provisions of Section 260553. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques--Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install wiring after the raceway system is completed and cleaned, and all work that may damage wiring has been completed.
 - 3. Pull conductors using only UL listed wire pulling lubricant and polypropylene dragline.
- E. Special Techniques - Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
 - 7. Arrange conductors in groups of three phases and neutral (if used) in wireways and large pullboxes
 - 8. Install splices only in junction boxes.
 - 9. In dry locations, splice conductors No. 8 AWG and smaller using insulated spring wire connectors or insulated crimp connectors. For conductors No. 6 AWG and larger, use uninsulated crimp connectors and apply electrical filler tape to fill the indentations, and rubber electrical tape to provide insulation equivalent to the conductor insulation.
 - 10. In damp locations, make splices similar to dry locations, with the addition of moisture-sealing tape over the insulation.
 - 11. In wet locations, make splices using uninsulated crimp connectors, and insulate with resin splice kits or heat-shrinkable splices.

12. For conductors No. 10 AWG and smaller, use terminals to connect to equipment designed for use with terminals.
13. For conductors No. 8 AWG and larger, use lugs to connect to flat bus bars or to equipment designed for use with lugs.
14. Arrange conductors in cabinets, panels, relay panels, etc., neatly cut to proper length, and remove surplus conductor. Terminate, bridle and secure in an approved manner. List all circuits emanating from power, distribution, and lighting panelboards by function on the directory card. Identify all circuits entering panelboards or other control cabinets by directory card listing terminal block number and function or by means of tags securely fastened to the conductors.
15. Single-phase branch circuits of different phases may be installed as multi-wire branch circuits having a common neutral conductor, except that lighting branch circuits shall not share a common neutral with receptacle branch circuits.

3.5 WIRE COLOR

- A. Refer to Section 260553

3.6 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.
- C. Testing Agency Qualifications:
 1. An independent testing agency with experience and capability to conduct testing without delaying the Work, as documented and according to NETA standards;
 - a. or a full member company of the International Electrical Testing Association.
 2. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. This section specifies furnishing, installing, connecting, and testing of a complete grounding and bonding system.
- D. All permanent or temporary metal structures shall be bonded to form a continuous conductive path. All structural steel, including, but not limited to, platform bents, overpass columns, stair stringers or canopy columns, shall be bonded to the main bonding conductor using a 4/0 AWG conductor. All terminations of the conductors shall be exothermic welded.
- E. All other non-structural steel shall be bonded to the main bonding conductor using a # 1/0 AWG conductor. This includes, but is not limited to, buildings, bridges, bungalows, fences, metal roofs of buildings, shelters, light poles, communication poles, power poles, metal handrails, metal guardrails, signs, vending machines, metal seating, metal expansion joints, and any ramps.

1.2 REFERENCE STANDARDS

- A. American National Standard Institute (ANSI) C33.8/UL6467 Grounding and Bonding Equipment, Safety Standard
- B. National Fire Protection Association (NFPA) 70-2017 National Electrical Code (NEC)
- C. American Society for Testing And Materials (ASTM) B3 Soft or Annealed Copper Wire
- D. National Electrical Safety Code (NESC) 9 Grounding

- E. Guide for Safety in AC Substation Grounding IEEE 80
- F. Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System IEEE 81
- G. Association of American Railroads (AAR)
- H. American National Standards Institute (ANSI)
- I. American Railway Engineering Association (AREA)
- J. Institute of Electrical and Electronic Engineers (IEEE) 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems
- K. Insulated Power Cable Engineers Association (IPCEA)
- L. NEMA National Electrical Manufacturers Association
- M. Underwriters Laboratories (UL) 467 Grounding and Equipment

1.3 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. In accordance with the General and Special Conditions, the Contractor shall submit: Certified test report stating that grounding system measures a maximum of 5 ohms to ground.

1.4 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.7 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING EQUIPMENT

- A. Ground Rods: Solid ground rod, copper or copper-clad steel, 3/4 inch diameter by 15 feet long, or of required length in 10 foot sections. The copper shall have a minimum wall thickness of 0.013 inch.
- B. Grounding Conductor: Ground electrode conductors: Insulated or bare conductor as shown, in accordance with the following requirements:
1. Insulated conductor: Conforming to the requirements for wire as specified elsewhere, NEC or ANSI C33.8/UL 467.
 2. Bare conductor ASTM B3: Soft-drawn tinned-copper conductor Class B stranded.
 3. Size: Ground wire embedded in foundations and aerial ground wire shall be 4/0 AWG stranded copper conductor. Connections from the ground grid to ground bus, building steel, and electrical panels shall be 4/0 AWG. Connections to buildings, bridges, bungalows, fences, and metal roofs of buildings, shelters, light poles, communication poles, power poles, metal handrails, metal guardrails, signs, vending machines, metal seating, metal expansion joints, and any ramps shall be # 1/0 AWG.
 4. Equipment grounding conductor: Conductors for grounding and bonding shall be ASTM B8, Class B stranded annealed copper, and sized as required. Conforming to the requirements of single-conductor cable as specified in Section 260519, size in accordance with Table 250-122 of NEC.
 5. Terminal lugs for 4/0 AWG and smaller conductor: Compression type copper terminal lugs.
 6. Main Ground connector: OZ, Type KG or equal, in accordance with the following requirements:
 - a. Two piece, designed for connecting grounding conductor to bus bar.

b. Copper alloy body and silicon bronze bolt, nut and washer with interlocking clamp.

7. Jumpers: Copper braided flexible jumper, size as required.

PART 3 - EXECUTION

3.1 GROUNDING

A. Scope:

1. The station grounding grid shall be installed as shown in plans. Additional grounding provisions which are not part of this contract may be required especially at existing metallic property fences, equipment houses and compounds, etc. which are in the vicinity of the new station. It is the responsibility of the owner to ensure through localized testing to establish if there are any dangerous touch or step potentials present at these out of scope locations and to add additional grounding provisions as required.
2. The grounding of the utility transformer and disconnect switch are not part of this contract; they shall be verify for suitability by this contractor before work starts. Any deviations from codes and standards will be brought to the Engineer's attention.

B. Installation:

1. The placement of the grounding grid conductor shall be 3' below grade and observe a minimum of 8" clearance shall be provided from foundations and other underground structures.
2. A 6" thick cohesive stone free soil jacket shall encase the #4/0 ground grid conductor to ensure a low impedance contact with the surrounding soil.
3. When installing the ground grid conductor the contractor shall ensure that no bird-caging of the conductor occurs.

B. Grounding Connections:

4. Exothermic weld buried ground connections. Make welds in accordance with manufacturer's requirements, clean and coat with before backfilling.

2. Use terminal lug to connect grounding conductor to equipment enclosure. Use ground connector to connect grounding conductor to equipment ground bus furnished within equipment. Secure connector or terminal lugs to the conductor to engage all strands equally. Install terminal lug using tools and pressure recommended by the manufacturer. Indent mark terminal lug with the number of dies used for installation.
- C. Ground Loop: Install ground grid consisting of grounding electrode conductors and ground rods buried in earth in a pattern and at locations as shown, with the following requirements:
1. Top of ground rod and grid conductor 30 inches below unfinished surface or 6 inches below bottom of finished floor slab.
 2. A #4/0 AWG bonding conductor shall be secured to the underside of the exiting platform on East Side, at least 12 inches from the edge of the train side of platform, by an approved method at no more than 5-foot intervals. On the West side of the platform the conductor is installed underground and protected in PVC coated RGS conduit where exposed.
 3. Interconnect ground rods using 4/0 AWG conductor.
- D. Equipment Grounding Conductor: Provide equipment grounding conductor for following services and as shown:
1. All feeders.
 2. All branch circuits.
- E. Grounding of Service Equipment by others: Ground service equipment in accordance with NEC. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.
- F. Grounding for Personnel Safety: Bond and ground exposed metallic structures in open areas to separate grounding electrode in accordance with the following requirements:
1. Light Standards: Bond and ground each light to a separate 3/4 inch diameter by 10-foot long ground rod, located in adjacent handhole, using 1/0 AWG insulated grounding conductor.
 2. Platform: Bond and ground all metallic equipment, structures, railings, benches, columns, fencings, trash cans, gutters, pay phones, shelters, TVM, and all metallic items within 25 feet of tracks, ladders, building

steel, water piping, etc., to main ground conductor run on underside of platform. For providing electrical continuity, where necessary, install flexible copper braided jumper or 4/0 AWG insulated grounding conductor.

3. Ground all temporary construction equipment and structures.
- G. Ground all separately derived systems according to Article 250 of the NEC. The grounding of these, such as 120/208V transformers will not be shown on the drawings but are the responsibility of the Contractor.
- H. Pad-mounted transformers install two ground rods per transformer and cable loop. Ground pad-mounted equipment and noncurrent-carrying metal items associated with by connecting them to underground cable and grounding electrodes.

3.2 FIELD QUALITY CONTROL

- A. The Contractor shall perform, or shall hire an accredited testing agency to perform, the necessary ground grid Testing inclusive of ground grid impedance, Touch Voltages, Step Voltages and GPR for the station. 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. Ground resistance is to not to exceed 5 ohms for ground grid/bus in main distribution panels. The Contractor shall provide additional grounding equipment until the ground resistance is measured consistently less than 5 ohms under dry conditions. 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.
- B. Perform tests, by the fall-of-potential method according to IEEE 81 as outlined in this section:
 - a. **Requirements** - The grounding system shall be tested in line with IEEE81-2012 recommendations to verify compliance with the specification and design presented in this study. The following aspects will need to be tested and recorded:
 - Ground Grid Resistance
 - Touch and Step Voltages
 - GPR Voltage Gradients

All test equipment shall have an in-date calibration certificate. Safety precautions specific to these tests should be observed. A method statement should be prepared and submitted by the contractor prior to any testing. Mitigation measures should be proposed for any transferred voltage

hazards identified during the tests subsequent to measured voltage gradients.

- b. **Ground Grid Resistance** - Subsequent to the installation of the ground electrode, a ground grid resistance measurement should be carried out to verify that the actual resistance to ground is consistent with the calculated value in this report. The Fall of Potential 62% method should be used for this site given its small size.

Safety precautions specific to this test should be observed. It should be ensured and verified that the location of the remote current probe is outside the influence area of the ground grid.

- c. **GPR Voltage Gradients** - Subsequent to carrying out ground grid resistance measurements, calculations might show that the ITU ground potential rise limits are exceeded. As a result, it may be necessary to chart the extent of the area where the relevant Hot Zone contour limit is exceeded by finding the appropriate voltage contour line using the Fall-of Potential test.

In order to identify the extent of the required GPR contour, the resistance magnitude when the potential probe is at the required voltage contour level should be calculated using approved methods. The Hot Zone should be plotted at several locations around the station perimeter. Where test leads are run through the battery storage yard to connect onto external leads care should be taken to minimize tripping hazards.

- d. **Touch and Step Voltages** - Measurements are required to quantify the actual touch and step voltages which a human will be exposed to during ground fault conditions. This is achieved by carrying out a current injection test and passing a current through the grounding system which is returned via a remote electrode.

Touch Voltage measurements should be carried out in the same way to the GPR Voltage Gradient plotting procedure but using a plate electrode of a standard size applied to the ground at a standard pressure in order to simulate the human foot. Particular attention should be paid to points where the highest prospective touch voltages are likely to occur such as at the following non-exhaustive locations:

- Immediately beyond the edge of the perimeter electrode;
- At the end of radial conductors beyond the perimeter electrode;
- At the perimeter fence;
- At the centre of large ground grid rectangles; and
- At positions where operators stand.

Step Voltages should be carried out in similar way but the voltage should be measured across a 1 m step distance. Measurements should be taken where the worst prospective step voltages are expected to occur such as at the following non-exhaustive locations:

- Above radial spur electrodes; and
- Immediately beyond the perimeter grid corners.

When carrying out touch and step potential measurements it should be ensured that the ground rod used for testing is sufficiently driven into the ground so that proper contact is made with the underlying soil layer

- C. 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.
- D. Install a driven ground rod at handholes close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before handhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor within handhole.
- E. To meet resistance requirements, install additional ground rods and 4/0 AWG cable as required.
- F. Test equipment enclosure, metallic conduit and raceway, fence, and light standards for continuity to grounding system.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. This section specifies the furnishing and installation of electrical equipment supporting devices complete in place.

1.2 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product data
- C. Related Sections:
 - 260533 - Raceway and Boxes for Electrical Systems
 - 260548 – Vibration and Seismic Control for Electrical Systems

1.3 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.6 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

1.7 GENERAL REQUIREMENTS

- A. **Underground Service:** Underground service into buildings shall terminate as indicated, service conductors shall be continuous to the interior terminating point indicated from the utility transformers. Connections of the underground service to the service switch, panelboard is included. Ends of the underground conduit shall be protected by threaded caps until connections are made.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. **Fasteners:** Furnish all fasteners and hardware compatible with the materials and methods required for attachment of supporting devices.
- B. **Slotted - PVC coated Type Concrete Inserts:** Galvanized pressed steel plate complying with ASTM A283; box-type welded construction with slot designed to receive steelnut and with knockout cover; hot-dipped galvanized in compliance with ASTM A386 and PVC coated.
- C. **Masonry Anchorage Devices:** Expansion shields shall be of Type 316 stainless steel as follows:
 - 1. Furnish expansion shields for machine screws and bolts 1/4 inch; head-out embedded nut type, multiple unit class, Group I, Type 1, Class 1.
 - 2. Furnish expansion shields for machine screws and bolts large than 1/4 inch in size; head-out embedded nut type, multiple unit class, Group I, Type 1, Class 1.
 - 3. Furnish bolt anchor expansion shield for lag bolts, stainless steel, long-shield anchors class, Group II, Type 1, Class 1.
 - 4. Furnish bolt anchor expansion shields for bolts, closed-end bottom bearing class, Group II, Type 2, Class 1.
 - 5. **Toggle Bolts:** Type 316 stainless steel tumblewing type. Type, class and style as required.

D. Nuts, Bolts, Screws and Washers:

1. General: Furnish Type 316 stainless steel fasteners for exterior use or where built into exterior walls. Furnish fasteners for the type, grade and class required for the particular installation.
2. Standard Nuts and Bolts: Regular hexagon head type, complying with ASTM A307, Grade A, Type 316 stainless steel material.
3. Lag Bolts: Square head type of Type 316 stainless steel.
4. Machine Screws: Type 316 stainless steel.
5. Wood Screws: Flat head Type 316 stainless steel.
6. Plain Washers: Round, general assembly grade Type 316 stainless steel.
7. Lock Washers: Helical spring Type 316 stainless steel.
8. "C" Beam Clamps: for conduit size and loading, malleable iron, PVC-coated.
9. Pipe Straps: 2 hole steel conduit straps Type 316 stainless steel.
10. Pipe Clamps: 1 hole malleable iron type clamps with Type 316 stainless steel clamp backs and hardware.
11. Channel Support System and Accessories: Provide 12 gage Type 316 stainless steel channel and accessories.
12. "C" beam clamps for hanger rods:
 - a. Hanger Rods/Rods: Unistrut Corp or approved equal.
 - b. All clamps shall be PVC coated with stainless steel rods.

2.2 HARDWARE FOR MOUNTING EQUIPMENT

- A. Hardware for mounting equipment shall be high strength (100 percent rust resistant) and conform with the latest American Standards and Practices. Samples shall be submitted for approval. The Engineer will decide on one or more types and he will direct the Contractor to guide himself accordingly in the usage thereof at specific locations.
- B. All anchor bolts shall be "Phillips Red Head Stud Anchor" type, or approved equal.
- C. All screws and bolts shall be stainless steel with stainless steel nuts and washers where required.
- D. Bolts, nuts and washers used for mounting fixtures shall be stainless steel and installed with proprietary screws to reduce vandalism. Heavy duty stainless steel flat washers and lock washers shall be provided with all screws and bolts. If required, and/or as shown on the drawings, equipment mounted in signal enclosures shall be attached to the walls, ceilings, floors, etc., of the enclosures by clamps as manufactured by "Unistrut" or approved equal.
- E. "Everdur 651", or approved equal, hexagonal head machine screws, bolts and nuts with bronze flat washers shall be used for installing copper ground bus.

2.3 CONDUIT

- A. Rigid hot-dipped galvanized steel conforming to the following:
 - 1. Rigid galvanized steel conduit and fittings shall conform to the requirements of UL 6 and UL 1242, for threaded type, respectively, conforming to NEMA RN1, type A40, manufactured by Allied Tube and Conduit or Wheatland Tube Company, except that hardness shall be nominal 85 shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, tensile strength shall be minimum 3500 psi, and aging shall be minimum 1000 hours Atlas Weatherometer.
- B. Polyvinyl chloride conduit, conforming to the following:
 - 1. Polyvinyl conduit and fittings U.L. listed, rated for use with 90 degree C conductors and be Schedule 80. Materials shall conform to NEMA specifications TC-2 (conduit), TC-3 (Fittings) and UL 651 (conduit) and 514b (Fittings). Conduit and raceway shall carry a UL label stamped on each 10 length; markings shall be legible and permanent.
 - 2. Conduit shall be made from polyvinyl chloride compound which includes inert modifiers to improve weatherability and heat distortion. Conduit and fittings shall be free of cracks, holes or foreign matter.
 - 3. Conduit, fittings and cement shall be produced by the same manufacturer to assure system integrity.
- C. PVC Coated Rigid Galvanized Steel Conduit:
 - 1. PVC-coated rigid steel conduit to comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
 - 4. Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

2.4 MATERIALS FOR HANDHOLES

- A. Handholes are referred to throughout this section as "structures" or "underground structures". Handhole frames and covers shall be as shown on the Contract Drawings.
- B. Brick shall be sewer and manhole brick conforming to ASTM C 32, grade MS.
- C. Metal Frames and Covers: Provide cast steel frames and covers conforming to Fed. Spec. RR-F-621 except where rolled steel floorplate is indicated.

- D. Handholes: Exterior handholes for platform area shall be designed and manufactured in accordance with ASTM C478 with additional stipulation that the concrete mix design shall be Class "A". Walls and base of handholes shall be reinforced concrete. Round frame and cover shall be #4.0 rated. Covers shall be cast with word "ELECTRIC" for power handholes and "COMM" for low voltage handholes. Covers shall be painted with stencil indicating handhole number. Numbering system shall be as directed by the owner. Handholes shall be provided with knocks on each wall. Provide with 1" PVC drain. Handholes for roadway lighting shall be Connecticut DOT Standard.

Exterior pullboxes cast into concrete shall be cast iron, size as indicated. Handholes shall be Connecticut DOT Standard conforming to Section 10.09 of CT DOT Standard Specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Attachment of Conduit System:
 - 1. Masonry Construction: Attach conduit to masonry construction by means of pipe straps or pipe clamps and masonry anchorage devices.
 - 2. Steel Beams: Attach conduit to steel beams by means of "C" beam clamps and hangers.
- B. A bracket and channel type support of PVC coated galvanized steel construction shall be provided wherever required for the support of starters, switches, panels and miscellaneous equipment. Such supports shall be rigidly bolted together and braced to make a substantial supporting framework. Where possible, control equipment shall be grouped together and mounted on a single framework. Wherever this occurs, a provision shall be made for ready access to the wiring for connections to the equipment by means of boxes with screw covers.
- C. Actual designs for supporting framework should take the nature of a picture frame of channels and bracket with a plate for mounting components. The Contractor is responsible for the design of supporting structure; he shall submit design details to the Engineer for acceptance before proceeding with the fabrication.
- D. PVC coated galvanized steel support systems shall be utilized in all exterior areas.
- E. The Contractor shall be responsible for the furnishing and installation of all conduit sleeves, anchor bolts, masonry inserts, and similar devices required for installation of equipment furnished under this Contract.
- F. If a time delay for the arrival of any special inserts, or equipment drawings, etc., occurs, the Contractor may, if permitted by the Engineer, make arrangements for providing approved recesses and openings in the concrete or masonry and upon subsequent

installation the Contractor shall be responsible for filling in such recesses and openings. Any additional costs that may be incurred by this procedure shall be borne by the Contractor.

- G. Where the weight of equipment exceeds 50 pounds and is supported from walls, ceilings, columns and/or beams, such supporting steel sizes, methods and locations shall be approved in writing by a Professional Engineer registered in the State of Connecticut.

3.2 CONCRETE

- A. Refer to Specification Division 03 for concrete requirements.

3.3 UNDERGROUND EXTERIOR SITE LIGHTING BRANCH CIRCUIT.

- A. Underground exterior site branch circuit wiring shall be installed in PVC Schedule 80 conduit, 18" below finished grade, except under paved areas raceways shall be rigid steel galvanized conduit, 18" below grade.

3.4 WARNING TAPES IN EARTH TRENCHES

- A. For the purposes of early warning and identification during future trenching or other excavation, continuous identification tapes shall be provided in the trench above duct banks.
- B. Tape shall be nonmagnetic plastic tape or aluminum foil plastic backed type manufactured for the purpose of early warning identification of utilities buried below the tape. Tape shall be at least 3 inches in width. Color of the tape shall be standard with the manufacturer for the type of utility buried below the tape.
- C. Tape shall have lettering at least 1-inch high with not less than the following identification on the tape: "CAUTION BURIED (ELECTRIC) (TELEPHONE) LINE BELOW".
- D. Tape shall be installed according to the printed recommendations of the tape manufacturer as modified herein. Tapes shall be buried at a depth of 6 inches below the top surface of earth; in pavements this 6 inches shall be measured from the top of the subgrade.

3.5 RECONDITIONING OF SURFACES

- A. Unpaved surfaces disturbed during the installation of duct shall be restored to their original elevation and condition. Sod or topsoil shall be preserved carefully and replaced after the backfilling is completed. Sod that is damaged shall be replaced by sod of quality equal to that removed. Where the surface is disturbed in a newly seeded

area, the restored surface shall be reseeded with the same quantity and formula of seed as that used in the original seeding.

- B. Paving Repairs: Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment or pavement shall be restored to the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces in a neat and acceptable manner

3.6 HANDHOLES

- A. Underground structures shall be poured in place or may be of precast construction as specified hereinafter. Horizontal concrete surfaces of floors shall have a smooth trowel finish. Concrete shall be cured by applying 2 coats of white pigmented membrane forming-curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound shall conform to ASTM C309. Duct entrances and windows shall be located near the corners of structures to facilitate cable racking. Covers shall fit the frames without under play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair their strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide all necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. The words "ELECTRIC" and "COMM" shall be cast in the top in all power and communications handhole covers, respectively. Handhole covers shall be provided with painted stencil indicating handhole number.
- B. Optional Precast Concrete Construction: In lieu of poured-in-place concrete manholes and handholes, the Contractor may, at his option, provide precast concrete structures, subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes and handholes.

Precast concrete structures shall have the same accessories and facilities as required for poured-in-place structures. Likewise, they shall have plan area and clear heights not less than those of poured-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work shall have an ultimate 28-day compressive strength of not less than 4000 pounds psi. Structures may be precast to the design and details shown for poured-in-place construction, precast monolithically and placed as a unit; or, they may be of assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. All structures shall be identified with the manufacturer's name embedded in, or otherwise permanently attached to, an interior wall face.

- C. Design for Assembled Units: Precast structures shall be designed in accordance with ACI 318 and shall be based on the following properties:

1. Angle of internal friction (ϕ) = 30 degrees Unit weight of soil = 110 pcf.
2. Lateral at rest earth-pressure coefficient = 0.50.
3. Structure top and bottom shall be designed for full dead, superimposed dead, and live load including impact. Structure sidewalls shall be designed for lateral earth and hydrostatic pressures plus live load (H20 truck) adjacent to structure. Tops and walls of structures shall be designed for AASHTO standard H20 highway loading, with 30-percent loading added for impact, and with design load being that which produces maximum shear and moment. All dead and live loads, as well as impact loading, shall be considered in design. Walls shall be designed to withstand all soil pressures, taking into consideration the soil to be encountered and ground water level present at the site, and assuming that the H20 design vehicle will operate on surfaces adjacent to the structure. Ground water level shall be assumed to be 3 feet below ground surface unless a higher water table is indicated in the boring logs. Design shall also take into consideration stresses induced in handling units. Lifting devices shall be provided for properly handling units. Calculations and shop drawings shall be submitted covering the design and manufacture of precast units and shall bear the seal of a Registered Engineer in the State of Connecticut.
4. Mating edges of precast components shall be provided with tongue-and-grooved joints. Joints shall be designed to firmly interlock adjoining components and to provide waterproof junctions. Joints shall be sealed watertight using preformed plastic strip conforming to AASHTO M198, Type B. Sealing material shall be installed in strict accordance with the sealant manufacturer's printed instructions. Provisions shall be made for waterproofing cable entrances into structures and at covers in the top slab.

- D. Metal Frames and Covers: Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled steel floorplate having an approved antislip surface. Hinges shall be of wrought steel, 5 by 5 inches by approximately 3/16 inch thick, without screw holes, and shall be for full surface application by fillet welding. Hinges shall have nonremovable pins and 5 knuckles. The surfaces of plates under hinges shall be true after the removal, by grinding or other approved method, of raised lugs. Frames and covers shall be grounded as shown on Drawings.

3.7 EARTHWORK

- A. Excavation for underground structures shall be to depths indicated. If hard material is encountered, the provisions of the Contract respecting an adjustment for changed conditions shall apply, subject to the requirements of notification thereunder being given. Hard material shall be defined as solid rock, firmly cemented unstratified masses, or conglomerate deposits possessing the characteristics of solid rock not ordinarily removed without systematic drilling and blasting, and any boulder, masonry, or concrete (except pavement) exceeding 1/2 cubic yard in volume.

- B. Excavated materials not required or suitable for backfill shall be removed from the project site. Provide sheeting and shoring as necessary for protection of work and safety of personnel. Remove water from excavation by pumping or other approved method.
- C. Backfilling around structures shall consist of earth, loam, sand-clay, or sand and gravel, free from large clods of earth or stones over 1 inch in size. Backfill materials shall be placed symmetrically on all sides in loose layers not more than 9 inches deep. Each layer compacted with mechanical or hand tampers to 90 percent compaction, ASTM D698 density.
- D. Backfilling Trenches: Backfill shall be placed in layers not more than 6 inches thick and each layer shall be compacted. Backfilling shall progress as rapidly as the construction, testing, and acceptance of the work permits. Backfill shall be free from roots, wood scrap material, and other vegetable matter and refuse. Compaction of backfill shall be to 90 percent of ASTM D698 density. The first layer shall be earth or sand, free from particles that would be retained on a 1/4-inch sieve and extending not less than 3-inches above the top of the cables. The succeeding layers shall be excavated material having stones no larger than would pass through a 4-inch ring. The backfill shall be level with the adjacent surface except that in sodded areas a space equal to the thickness of the sod shall be left

3.8 CONDUIT INSTALLATION

- A. Conduit embedded in concrete shall be PVC or hot dip rigid galvanized steel.
- B. Exposed conduit and fittings, on platform and wet locations shall be hot dip rigid galvanized steel with 40 mil PVC coating, color as selected by architect.
- C. Conduit for underground exterior site shall be PVC Schedule 80, except under paved areas it shall be PVC coated rigid steel galvanized conduit.

END OF SECTION 260529

SECTION 260533 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 INFORMATION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.2 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.
- C. Section includes conduit, pull and junction boxes.
- D. Related Sections:
 - 1. Section 260526 - Grounding and Bonding for Electrical Systems.
 - 2. Section 260529 - Hangers and Supports for Electrical Systems.
 - 3. Section 260553 - Identification for Electrical Systems.
- E. The Contractor shall supply, install, test and commission into service, all conduits indicated on the drawings.
- F. The Contractor shall be responsible to obtain all existing conduit route details in the field to ensure that the new conduit routes can be accommodated and that all routes can be supplied and installed to fit existing conditions.
- G. The Contractor shall provide new conduit route drawings for the new conduit routes being installed.

1.3 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. Underwriters Laboratories, Inc. (UL):
 - 1. 50, Enclosures for Electrical Equipment
 - 2. 514A,B, Metallic Outlet Boxes and Fittings

1.4 SYSTEM DESCRIPTION

- A. In Slab: Provide rigid steel conduit. Provide cast or nonmetallic metal boxes.
- B. Wet and Damp Outdoor Locations: Provide PVC coated rigid steel conduit. Provide PVC coated cast metal outlet, junction and pull boxes. Provide flush mounting outlet box in finished areas.
- C. Concealed Dry indoor Locations: Provide rigid steel. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- D. Exposed Dry Outdoor Locations: Provide PVC coated rigid steel conduit. Provide PVC coated sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.5 DESIGN REQUIREMENTS

- A. Minimum conduit size 3/4".

1.6 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: Submit for the following:
 - 1. PVC coated rigid steel conduit
 - 2. PVC Schedule 80 conduit
 - 3. Liquidtight flexible metal conduit.

4. Raceway fittings.
5. Conduit bodies.
6. Wireway.
7. Pull and junction boxes.

C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.7 CLOSEOUT SUBMITTALS

A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.8 QUALITY ASSURANCE

A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.9 DELIVERY, STORAGE AND HANDLING

A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.10 WARRANTY

A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

PART 2 PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers:

1. Allied Tube and Conduit.

Or

2. Approved equal

B. PVC coated Rigid Steel Conduit: UL 6.

C. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit

2.2 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. Electri-Flex Company (Liquatite – Non-PVC).
 - Or
 - 2. Approved equal
- B. Product Description: Interlocked steel construction with weather-tight PVC jacket. Per UL 1660
- C. Fittings: NEMA FB 1.

2.3 PULL AND JUNCTION BOXES

- A. Manufacturers:
 - 1. OZ Gedney.
 - Or
 - 2. Approved equal.
- B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- C. Enclosures: comply with NEMA 250 as follows:
 - 1. Generally all indoor areas and dry locations: NEMA 1.
 - 2. Damp locations: NEMA 4.
 - 3. Wet locations: NEMA 4 or 4X.
- D. Sizes shall provide sufficient space for pulling, racking, or splicing.
- E. All boxes shall have covered secured with screwed or bolted fixings. Hinged covers shall not be provided.

PART 3 EXECUTION

3.1 PREPARATION

- A. Transmit submittals required by this Section.
- B. Furnish products as indicated.
- C. Ensure substrates are in suitable condition to receive the work.

3.2 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.3 EXISTING WORK

- A. Not applicable

3.4 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 260526.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 260529.
- C. Identify raceway and boxes in accordance with Section 260553.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.5 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- E. Do not attach raceway to ceiling support wires or other piping systems.
- F. Route exposed raceway parallel and perpendicular to walls.
- G. Route conduit in and under slab from point-to-point.
- H. Maintain clearance between raceway and piping for maintenance purposes.
- I. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
- J. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations.

- K. Install no more than equivalent of four 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams.
- L. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- M. Install fittings to accommodate expansion and deflection where raceway crosses control and expansion joints.
- N. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- O. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- P. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

3.6 INSTALLATION – BOXES

- A. The location of all boxes shall be approved by the Engineer prior to completion of roughing-in. No final box locations will be permitted without this approval. No thru boxes shall be permitted.
- B. Pull boxes and junction boxes shall be installed as required by NEC and in all runs of raceway having more than 100 feet in length or the equivalent of four (4) 90° bends; entirely accessible; stainless steel or PVC coated RGS up to 12" × 12" size and #10 gauge over 12" × 12" size; complete with covers of same gauge as boxes and secured to the box with screws; be securely mounted to building structure independent of the raceways connected to them. Pull boxes shall be indicated on the Contractor's Shop Drawings.
- C. Install wall mounted boxes at elevations to accommodate mounting heights.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. Do not fasten boxes to ceiling support wires or other piping systems.
- F. Install boxes in a secure, substantial manner, supported independently of raceway by attachment to the building structure or a structural member. Use bar hangers in frame construction, or fasten boxes directly with wood screws on wood, bolts and expansion shields on concrete or brick, toggle bolts on hollow masonry units and machine screws or welded threaded studs on steelwork. Threaded studs driven in by a powder charge and provided with lock washers and nuts are not acceptable in

lieu of expansion shields. Boxes embedded in concrete or masonry need not be additionally supported. Utilize galvanized mounting hardware in battery room area.

- G. Boxes installed in damp areas, and where specified shall be gasketed cast metal type having threaded hubs.
- H. Mount all boxes plumb and level. Use flush-mounted boxes with concealed conduits. Make edges of boxes flush with finished surface. Provide proper type extension rings or plaster covers for this purpose. For flush-mounted boxes, make holes in the surrounding surface no larger than required to receive the box.

3.7 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements

3.8 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. The extent of underground electrical work shall be as indicated on the drawings.
- D. Section 260500 applies to this Section.

1.2 REFERENCE STANDARDS

- A. American Concrete Institute (ACI)
 - 315 Detailing Reinforced Concrete Structure
 - 318 Building Code Requirements for Reinforced Concrete, including Commentary
- B. American National Standards Institute (ANSI)
 - C2 National Electrical Safety Code (NESC) 2017
- C. American Society for Testing and Materials (ASTM)
 - B1 Hard Drawn Copper Wire
 - B8 Concentric-Lay Stranded Conductors, Hard, Medium-Hard or Soft.
 - C309 Liquid Membrane Forming Compounds for Curing Concrete
- D. National Fire Protection Association (NFPA)
 - 70-2017 National Electrical Code (NEC)
- E. Underwriters Laboratories, INC. (UL)
 - 6 Rigid Metallic Conduit
 - 467 Grounding and Bonding Equipment.
 - 510 Insulating Tape
 - 514 Outlet Boxes and Fittings.

854 Service-Entrance Cables
1242 Intermediate Metal Conduit

1.3 GENERAL REQUIREMENTS

- A. Electrical characteristics: Electrical characteristics for this project shall be 480/277VAC, three phase, 4-wire, 60-hertz and 120/208VAC, three phase, 4 wire.

1.4 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Manufacturer's Data:

1. Conduit
2. Splice Box
3. Insulating Tape
4. Terminator
5. Handhole frame and cover
6. Sealing material for precast manhole and handhole joints
7. Wire and cable

C. Shop Drawings:

1. Material description
2. Manufacturer's printed assembly and installation instructions. Drawing must be sealed by Connecticut State Professional Engineer.
3. Design calculations must be submitted and sealed by Connecticut State Professional Engineer.
4. Reinforcing shop drawings prepared in accordance with AC1-315.

D. Manufacturer's Instructions:

1. Manufacturer's instructions for use of ground megger with proposed method indicated.
2. Termination manufacturer's installation instructions.

E. Certificates:

1. Provide manufacturer's statement certifying that material and equipment supplied meets or exceeds specification requirements.
2. Handhole and accessories.
3. Cable splicer's certificate of competency.

1.5 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.8 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Provide materials and equipment listed by UL or approved by Factory Mutual (FM) Systems when such is listed or approved.

2.2 TAPE

- A. Plastic insulating tape shall conform to the requirements of UL 510 and ASTM Des. D119.

2.3 WIRE AND CABLE

- A. Conductor and conduit sizes indicated for copper conductors shall bear the date of manufacture imprinted on the wire insulation with other identification. Wire and cable manufactured more than 6 months before delivery to the jobsite shall not be used.
- B. Conductors rated 600 volts or less, including service entrances, shall conform to Section 260519.

- C. Telephone Wire and Cable: Telephone cables shall conform to REA (BUL 345-14) (BUL 345-67) and Section 260519 and shall have the number of pairs indicated.
- D. Pull Wire: Pull wire shall be plastic having a minimum tensile strength of 250 pounds shall be provided the entire length of all unused ducts. Minimum 12 inches of slack shall be left at each end of pull cord.
- E. Connectors and Terminals: Connectors and terminals shall be designed and approved for use with the associated conductor material and shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on all stranded conductors.

2.4 GROUNDING

- A. Grounding and bonding equipment shall conform to UL 467 and Section 260526. Ground rods shall be copperweld copper-clad steel with diameter adequate to permit driving to full length of the rod but not less than 1 inch in diameter and 10 feet long unless otherwise indicated. Ground rods shall be driven adjacent to each manhole and handhole or other concrete box.

2.5 CONDUIT AND FITTINGS

- A. Rigid galvanized steel, PVC-coated conduit, comply with NEMA RNI, shall be 40 mil dense polyvinyl chloride coating on exterior with cured 2 mil urethane interior. All fittings shall be of same finish. Conduit shall be as manufactured by OCAL, color as selected by Architect (special color to be selected.)
- B. PVC Schedule 80 conduit for underground site installation and fittings shall be manufactured in accordance with NEMA TC2. PVC fittings shall be rated UL 651; for boxes UL 514C.

2.6 OUTLET AND DEVICE BOXES AND COVERS

- A. UL standard 514, cadmium or zinc coated if of ferrous metal for exterior and platform outlet boxes and covers. Type "FS" or "FD" iron alloy and coated with 40 mils of PVC, interior of box shall be coated with 2 mil urethane and shall use Type 316 stainless steel screws for mounting, manufactured by Robroy Industries, Plastibond Series, or OCAL, Inc., or approved equal. Color as selected by Architect.
- B. Sheet metal outlet and device boxes, NEMA OS1.

2.7 CABINETS, JUNCTION BOXES, WIREWAYS AND PULL BOXES (WITH VOLUME GREATER THAN 100 CUBIC INCHES)

- A. Small sheet metal pull and junction boxes, NEMA OS1.
- B. Metal wireways shall be UL listed and conform to NEMA 250, interior, Type 1, covers shall be screwed on. Finish shall be standard enamel.
- C. Cast metal pull and junction boxes, NEMA FB1, cast-iron.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Underground installation shall conform to ANSI C2 and NFPA 70-2005, except as otherwise specified or indicated.

3.2 CONTRACTOR DAMAGE

- A. The Contractor shall promptly repair any utility lines or systems damaged by his operations. Immediately notify the Engineer of any such damage.

3.3 CABLE PULLING

- A. Raceways shall be tested with a mandrel and thoroughly swabbed out to remove foreign material before the pulling of cables. Cables shall be pulled down grade with the feed-in point at the handhole or buildings of the highest elevation. Flexible cable feeds shall be used to convey cables through the handhole opening and into the duct runs. Cable lubricants shall be soapstone, graphite, or talc for rubber or plastic-jacketed cables.
- B. Lubricants for assisting in the pulling of lead, neoprene and polyethylene-jacketed cables shall be those specifically recommended by the cable manufacturer.
- C. Cable pulling tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.
- D. Secondary cable runs, 600 volts and less, shall include an insulated copper equipment grounding conductor sized as required by the rating of the overcurrent device supplying the phase conductors.
- E. Installation of Cables in Handholes: Cables shall not be installed using the shortest route but shall be routed along those walls providing the longest route and the maximum spare cable lengths. All cables shall be formed to closely parallel walls, not to interfere with duct entrances, and shall be supported on brackets and cable insulators at a maximum of 4 feet. Each cable shall be identified by corrosion resistant embossed

metal tags attached in each underground structure in accordance with contract drawings and as approved by the Engineer. Each phase of the cable shall be identified.

3.4 CABLE TERMINATING

- A. Terminations of insulated power and lighting cables shall be protected from accidental contact, deterioration of coverings, and moisture by the use of terminating devices and materials. Terminations shall be made using materials and methods as indicated or specified herein or as designated by the written instruction of the cable manufacturer and termination kit manufacturer.
- B. Termination for cables shall be rated and be capable of withstanding test voltages, in accordance with the IEEE 48.
- C. Terminations of single and multi-conductor cables shall include the securing and sealing of the sheath and insulation of the cable conductors, stress relief, and grounding of cable shields of shielded cable, and grounding of neutral conductors, metallic sheaths, and armor.
- D. Cables and cable terminations shall be adequately supported so as to avoid any excessive strain on the termination and the conductor connection.

3.5 CONDUIT INSTALLATION

- A. Conduit and fittings, exposed conduit and fittings, on platform and wet locations shall be PVC coated RGS, PVC color as selected by architect.
- B. Interior conduit in dry locations shall be rigid galvanized steel.
- C. Conduit for underground exterior site shall be PVC Schedule 80, except under paved areas it shall be PVC coated rigid galvanized steel conduit.
- D. Connections to vibrating equipment (including transformers) shall be liquidtight flexible metallic conduit.
- E. Minimum conduit size shall be 3/4-inch. Home runs to panelboards shall not be less than 1-inch conduit. Conduit shall be installed in compliance with the NEC.
- F. Unless indicated otherwise, all conduit shall be concealed within finished walls, ceilings, concrete walls and floors.
- G. Keep conduit at least 18 inches away from parallel runs of water pipes.
- H. Supports for Exterior Installations: Conduit shall be supported by Type 316 stainless steel wall brackets, hangers, (1-hole malleable iron pipe straps and clamp back) Fastenings shall be by Type 316 stainless steel toggle bolts on hollow masonry units; by

concrete inserts or Type 316 stainless steel expansion bolts on concrete or brick; by Type 316 stainless steel, welded threaded studs, on steel work. PVC coated steel threaded C-clamps shall be used on 40 mil PVC coated rigid steel conduit. Conduit straps for PVC coated conduit shall be PVC coated. Conduits or pipe straps shall not be welded to steel structures. The load applied to fasteners shall not exceed one fourth of the proof test load. Fasteners attached to concrete ceiling shall be vibration and shock resistant.

- I. Supports for Interior Installations: Conduit shall be supported by pipe straps, wall brackets, hangers, or ceiling trapeze. Fastenings shall be by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; by machine screws or welded threaded studs on steel work. Threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine or wood screws. Threaded C-clamps may be used on rigid steel conduit only. Conduits or pipe straps shall not be welded to steel structures. The load applied to fasteners shall not exceed one fourth of the proof test load. Fasteners attached to concrete ceiling shall be vibration and shock resistant. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete. Joints shall not cut the main reinforcing bars. Holes not used shall be filled. In partitions of light steel construction, sheet-metal screws shall be used. In suspended-ceiling construction, conduit shall be run above the ceiling.
- J. Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall not be acceptable. Crushed or deformed conduit shall not be installed. Trapped conduits shall be avoided. Plaster, dirt, and trash shall be prevented from lodging in conduits, boxes, fittings, and equipment during construction. Clogged conduit shall be freed of all obstructions.
- K. Empty conduit in which wire is to be installed by others shall have pull wires installed. The pull wire shall be of plastic having not less than 200-pound tensile strength. Not less than 12 inches of slack shall be left at each end of the pull wire.
- L. Telephone and signal system conduit shall be installed in accordance with the previous requirements for conduit and with the additional requirements that no length of run shall exceed 100 feet for one inch or larger trade sizes and shall not contain more than two 90-degree bends or the equivalent. Pull and junction boxes shall be installed to comply with these requirements. Inside radii of bends in conduits 1-inch trade size and larger shall be not less than 10 times the nominal diameter.
- M. Conduit installed in concrete floor slabs shall be located so as not to adversely affect the structural strength of the slabs. Conduit shall be installed within the middle one-third of the concrete slab. Conduit shall not be stacked. Conduits shall be spaced horizontally not closer than 3 diameters except at cabinet locations. Curved portions of bends shall be increased as necessary to provide a minimum 1-inch cover over conduit. Where conduits cross expansion joints, suitable watertight expansion fittings and bonding jumpers shall be provided. Conduit larger than 1-inch trade size shall be parallel to or at right angles to the reinforcement, the conduit shall be close to one of the supports of

the slab. Conduit installed beneath floor slabs shall be encased in a minimum of 3 inches of concrete.

- N. Conduits shall be fastened to all metal boxes and cabinets with two locknuts. Where insulated bushings are used and where bushings cannot be brought into firm contact with the box, at least two locknuts and bushing shall be used. Locknuts shall be the type with sharp edges for digging into the wall of metal enclosures. Bushings shall be installed on the ends of all conduits and shall be of the insulating type.
- O. Conduits stubbed up through concrete floors for connections to free-standing galvanized equipment shall be provided with a short hot dip rigid galvanized steel conduit elbow for exterior installations. For interior installations, connections to free-standing equipment shall be provided with a short elbow and an adjustable brass top set flush with the finished floor. Screwdriver-operated or recessed-square-socket-type threaded flush plugs shall be installed in conduits from which no equipment connections are made.
- P. Flexible connections of short lengths shall be provided for equipment subject to vibration, noise transmission, or movement and for all motors. Liquidtight flexible conduit shall be used in all exterior locations. A separate ground conductor shall be provided across all flexible connections.
- Q. Flexible metal conduit in general shall be the same size as the branch conduit. Where necessary for recessing devices, 1/2 inch flexible metal conduit may be used. In special circumstances and with approval of the Engineer, 3/8 inch flexible metal conduit may be used where permitted by Articles 350-10 of the NEC and in conformance with local codes.
- R. Installation of the flexible metal conduit shall comply with Article 350 and applicable provisions of Articles 300, 348 and 350 of the NEC.
- S. Approved conduit expansion joints shall be provided wherever conduit crosses a structural expansion joint, is attached between two separate structures, and wherever the conduit run is 100 feet or more in a single straight length. Joints shall be O.Z. Gedney Type DX, Crouse Hinds Type XD or approved equal.
- T. All conduit extending through the floor, behind panels or into control centers or similar equipment shall extend a minimum of 6 inches above the floor elevations, with no couplings at floor elevations, and shall be surrounded with a sealing bushing equal to O.Z. Gedney Type CSB.
- U. Except as shown on the Contract Drawings the minimum size conduit permitted is 3/4 inch for exposed work and 1 inch for conduit encased in concrete or mortar.
- V. Each piece of conduit installed shall be free from blisters and other defects. Each piece installed shall be cut square, taper reamed, and a coat of sealing compound applied to threads. Conduit connections shall be screwed tight with only incomplete threads exposed. All conduit joints shall be made with standard couplings and the ends of the

conduit shall butt tightly into the couplings. In exposed work only, where standard couplings cannot be used, only Erickson couplings are permitted, or as otherwise acceptable to the Engineer.

- W. Conduit threaded in the field shall have standard sizes and lengths.
- X. The equivalent number of 90° bends in a single conduit run are limited to the following.
 - Runs in excess of 300 feet 0
 - Runs of 300 feet to 201 feet 1
 - Runs of 200 feet to 101 feet 2
 - Runs of 100 feet and less 3

Factory bent elbows or field bent elbows made with approved tools may be used. Heating of conduit to facilitate bending is prohibited.

- Y. All exposed conduit shall be installed either parallel or perpendicular to structural members, unless impractical, and shall be grouped wherever possible. Conduit shall be attached to structural components with approved supports spaced a maximum of five (5) feet apart and shall form a neat rigid installation. Conduit supported from building walls shall be installed with at least 1/4 inch clearance from the walls to prevent the accumulation of dirt and moisture behind the conduit. Provide PVC coated conduit spacers (clamp backs).
- Z. Conduit and/or conduit fittings shall not be welded together or to any steel structure; however, conduit supports may be welded to flanges of steel beams, columns, etc., in accordance with approved welding techniques and engineering practice.
- AA. Conduit installed in concrete or other masonry walls shall be so arranged that a minimum of 3 inches of covering is obtained. Spacings between conduits shall be sufficient to permit a complete filling with concrete or mortar without voids.
- BB. The cutting of walls or floors for conduit shall be kept to a minimum. Where such cutting is absolutely necessary, care must be taken so as not to weaken the walls or floor involved. Beams or other structural supports shall not be cut under any condition. Holes through existing concrete slab must be core drilled.
- CC. Conduit shall be protected immediately after installation by installing flat non-corrosive metallic discs and steel bushings, designed for this purpose, at each end. Discs shall not be removed until it is necessary to clean the conduit and pull wire and cable. Before wire or cable is pulled, insulated bushings shall be installed at each end of the conduit.
- DD. Where all thread nipples are used between fittings and electrical equipment, they shall be so installed that no threads are exposed. All exposed threads shall be PVC coated.

- EE. Connections from rigid conduit to motors, limit switches, solenoid valves, level controls, etc., shall be made with short lengths of liquid-tight flexible PVC jacketed metal conduit equal to Type "LA" Electri-Flex, Type "ULTRATITE" Alfex Corporation, or Type "VA" Annaconda. These lengths shall be provided with appropriate connectors with devices which will provide an excellent electrical connection between equipment and the rigid conduit for the flow of ground current.
- FF. All threaded ends of conduits shall be coated with an approved conducting compound such as Thomas Betts "Kopr-Shield" compound prior to making up the point.
- GG. All exposed conduits rising above finished floor elevation, excluding those encompassed by an equipment pad, shall be provided with a 4-inch high curb. Three (3) inches of cover shall be provided horizontally around the conduit. Conduits shall be PVC coated rigid steel.
- HH. Conduit passing through the walls and floors of buildings below grade shall be installed with appropriate watertight fittings to prevent the entrance of ground water around the periphery of the conduits. Conduits shall be sloped away from the buildings toward splice boxes, handholes and/or manholes to provide drainage away from the building wall. Conduits shall be encased in reinforced concrete with a minimum of 3" of cover over the conduit.
- II. Conduit attachment to all electrical equipment, such as stainless steel junction boxes, pullboxes, switches, etc., shall be made with double steel locknuts. Threaded insulated bushings shall be used on the end of each conduit terminating in such equipment.
- JJ. Where plastic coated conduit and fittings are specified, plastic coatings damaged during transportation, loading, installation, etc., or cut during threading shall be repaired with the same type of covering obtained from and in accordance with the manufacturer's recommendations.
- KK. Conduits passing through sleeves in walls and floors shall be tightly caulked. Sleeves shall be sealed to walls with expanding epoxy grout.
- LL. When installing PVC conduit use only a vice approved for PVC conduit. The use of a chain vice will not be permitted.
- MM. Conduit expansion fitting shall be equal to Crouse Hinds Type XD, OZ Gedney Type DX or equal for non-explosive areas.
- NN. Conduit penetrating fire rated wall shall be provided with fire seals equal to OZ Gedney Type CFS.
- OO. Conduit installation shall be arranged to minimize cleaning. No horizontal runs of conduit will be permitted in brick or masonry walls.
- PP. Conduits shall be supported with approved fittings. The support system shall not permit deflections to exceed 1/100 of the span.

- QQ. Conduit and ducts shall be caulked and sealed immediately after the wires and cables have been installed. The conduit bushings shall be thoroughly caulked with oakum, using wooden tools with rounded edges, and sealed with "Duxseal" waterproofing compound, Johns-Manville Corp. or approved equal. The compound shall be painted with one coat of approved insulated paint.

3.6 FURNISHING AND INSTALLING FERRULES AND FERRULE CONDUITS

- A. Waterproof ferrules for electrical conduits shall be provided in the exterior walls, ceilings or floors of the enclosures. All waterproof ferrules for electric conduits shall be installed as directed by the client. The Contractor shall submit drawings showing method of installation.
- B. Ferrules shall consist of extra heavy galvanized steel pipe with flanges set in the wall or floor of the enclosures, waterproofed with brick in mastic in an approved manner. Sufficient membrane waterproofing shall be provided to properly lap over the waterproofing of the existing structure and to act as a base for the brick-in-mastic. Membrane waterproofing shall consist of three layers of treated cotton fabric mopped with asphalt.
- C. Steel feed conduits shall be provided through ferrules. The space between the conduit and the ferrule shall be caulked with oakum and lead wool. The conduit shall be encased in concrete and shall extend to locations indicated on the Contract Drawings.

3.7 BOXES, OUTLETS AND SUPPORTS

- A. Boxes shall be provided in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Outlet and device boxes for PVC coated metallic raceways shall be of the cast-metal hub type coated with 40 mils of PVC, when located on platform or other wet locations. Each box shall have the volume required by the NEC for the number of conductors in the box. Boxes for mounting lighting fixtures shall be not less than 4 inches square or octagonal except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes installed for concealed wiring shall be provided with suitable extension rings or plastic covers, as required. Boxes for use in masonry-block or tile walls shall be square-cornered tile-type, or standard boxes having square-cornered tile-type covers.
- B. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided. Boxes and pendants for surface-mounted fixtures on suspended ceilings shall be supported independently of the ceiling supports, or adequate provisions shall be made for distributing the load over the ceiling support members in an approved manner.
- C. For Exterior Installations and Platform:

1. Outlet and device boxes shall be Type "FS" or "FD" PVC coated.
2. Junction and pull boxes shall be PVC coated RGS or stainless steel.
3. Boxes and supports shall be fastened with Type 316 stainless steel bolts and expansion shields on concrete or brick, with Type 316 stainless steel toggle bolts on hollow masonry units, and with Type 316 stainless steel machine screws or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts may be used in lieu of expansion shields, or machine screws. PVC coated cast-metal boxes having threaded connectors shall be supported directly from the building structure or by Type 316 stainless steel bar hangers. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved fastener not more than 24 inches from the box. Penetration into reinforced concrete members shall avoid cutting any reinforcing steel.
4. Boxes for use with raceway systems shall not be less than 1-1/2 inches deep except where shallower boxes required by structural conditions are approved. Boxes for other than lighting-fixture outlets shall be not less than 4-1/2 inches by 2-3/4 inches unless otherwise noted. Telephone outlets shall be a minimum of 4 inches by 2-3/4 inches by 1-1/2 inches deep.
5. Pull boxes of not less than the minimum size required by the NEC shall be cast iron boxes. Boxes shall be furnished with Type 316 stainless steel screw-fastened covers. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation.

D. For Interior Installations:

1. Boxes and supports shall be fastened on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts may be used in lieu of expansion shields, or machine screws. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved fastener not more than 24 inches from the box. Penetration into reinforced concrete members shall avoid cutting any reinforcing steel.
2. Boxes for use with raceway systems shall not be less than 1-1/2 inches deep except where shallower boxes required by structural conditions are approved. Boxes for other than lighting-fixture outlets shall be not less than 4 inches square except that 4-inch-by-2-inch boxes may be used where only one raceway enters the outlet. Telephone outlets shall be a minimum of 4 inches square by 1-1/2 inches deep.
3. Pull boxes of not less than the minimum size required by the NEC shall be constructed of code-gauge galvanized sheet steel except where cast-metal boxes are required in locations specified above. Boxes shall be furnished with screw-fastened covers. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation.

4. Where conduits are connected to boxes or equipment enclosures through drilled holes or full size knockout openings, electrical continuity for grounding shall be assured by the use of bonding type locknuts or copper grounding wedges having set screws made up tight to bushings. Where connections are at eccentric or concentric knockouts, jumper type grounding bushings and wire jumpers shall be installed. At pull and junction boxes having any box dimension in excess of 18 inches and having a total of more than 4 conduit terminations, jumper type grounding bushings shall be installed on conduit ends and jumper wires shall be installed to bond all conduits and to bond conduits to boxes.
 5. Should any structural difficulties prevent the setting of boxes at points shown on the plans, deviations therefrom as determined by the Engineer will be permitted and shall be made without additional cost.
 6. A run of conduit between outlet and outlet, between fitting and fitting or between outlet and fitting shall not contain more than the equivalent of four quarterbends, including those bends located immediately at the outlet or fitting.
 7. All junction boxes and pullboxes shall have identifying nameplates attached thereto, which when installed on sidewalk type boxes shall not extend above the surrounding concrete slabs.
- E. Barriers: Galvanized steel barriers shall be provided in junction or pullboxes to isolate conductors of different voltages such as 480V, 120V, AC. The gauge of these barriers shall not be less than the gauge of the box required.

END OF SECTION 260543

SECTION 260548 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.
- C. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Seismic restraints for electrical equipment and systems.
 - 3. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IBC: International Building Code.
- C. IMC: Intermediate metal conduit.
- D. NBC: National Building Code.
- E. OSHPD: Office of Statewide Health Planning and Development.
- F. RMC: Rigid metal conduit.
- G. SBC: Standard Building Code.
- H. Seismic Restraint: A structural support element such as a metal framing member, a cable, an anchor bolt or stud, a fastening device, or an assembly of these items used to transmit seismic forces from an item of equipment or system to building structure and to limit movement of item during a seismic event.

I. UBC: Uniform Building Code.

1.4 SUBMITTALS

A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
2. Annotate to indicate application of each product submitted and compliance with requirements.

B. Shop Drawings: Indicate materials and dimensions and identify hardware, including attachment and anchorage devices, signed and sealed by a qualified professional engineer. Professional engineer qualification requirements as specified:

1. Fabricated Supports: Representations of field-fabricated supports not detailed on Drawings.
2. Seismic Restraints: Detail anchorage and bracing not defined by details or charts on Drawings. Include the following:
 - a. Design Analysis to support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details:
Detail 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.
 - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For testing agency.

F. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Comply with seismic-restraint requirements in the UBC unless requirements in this Section are more stringent.
- C. Testing of Seismic Anchorage Devices: Comply with testing requirements in Part 3
- D. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.8 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

1.9 PROJECT CONDITIONS

- A. Site Class as Defined in the IBC: C.
- B. S_s , Mapped Maximum Considered Earthquake Spectral Response at Short Periods: 32.
- C. S_1 , Mapped Maximum Considered Earthquake Spectral Response at 1-Second Period: 9.
- D. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- 1. Subject to compliance with requirements, provide products for engineer's approval for the components listed below:

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of five times the applied force.

- B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly.
1. Available Manufacturers:
 - a. Unistrut Co.
 - Or
 - b. Approved equal
 2. Finishes:
 - a. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.
 - b. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-3.
 - c. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-3.
 3. Channel Dimensions: Selected for structural loading and applicable seismic forces.
- C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
1. Available Manufacturers:
 - a. Cooper Industries.
 - Or
 - b. Approved equal
 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 4. Rated Strength: Selected to suit structural loading and applicable seismic forces.
- D. Raceway and Cable Supports: As described in NECA 1.
- E. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- F. 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.
- G. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

H. 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.

a. Available Manufacturers:

- 1) Hilti, Inc.
Or
- 2) Approved equal

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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:

- 1) Cooper Industries.
Or
- 2) Approved equal

3. Concrete Inserts: Steel or malleable-iron slotted-support-system units similar to MSS Type 18; complying with MFMA-3 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, high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.3 SEISMIC-RESTRAINT COMPONENTS

A. Rated Strength, Features, and Application Requirements for Restraint Components: As defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension, shear, and pullout force of components used shall be at least five times the maximum seismic forces to which they will be subjected.

B. Angle and Channel-Type Brace Assemblies: Steel angles or steel slotted-support-system components; with accessories for attachment to braced component at one end and to building structure at the other end.

C. Cable Restraints: ASTM A 603, zinc-coated, steel wire rope attached to steel or stainless-steel thimbles, brackets, swivels, and bolts designed for restraining cable service.

1. Available Manufacturers:
 - a. Amber/Booth Company, Inc.
Or
 - b. Approved equal
2. Seismic Mountings, Anchors, and Attachments: Devices as specified in Part 2 "Support, Anchorage, and Attachment Components" Article, selected to resist seismic forces.
3. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod, of design recognized by an agency acceptable to authorities having jurisdiction.
4. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to type and size of anchor bolts and studs used.
5. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to type and size of attachment devices used.

2.4 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 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, IMC, and RMC as required by 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 trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
 2. Secure raceways and cables to these supports with two-bolt conduit 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 AND SEISMIC-RESTRAINT INSTALLATION

- A. Comply with NECA 1 for installation requirements, except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70-2005.
- C. Install seismic-restraint components using methods approved by the evaluation service providing required submittals for component.
- D. 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. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- E. 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: 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.
- F. 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 Division 05 Section "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.

3.4 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and seismic criteria at Project.
- B. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so expansion anchors will be a minimum of 10 bolt diameters from edge of the base.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of the base.
 - 2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 6. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

3.5 INSTALLATION OF SEISMIC-RESTRAINT COMPONENTS

- A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- 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. Restraint Cables: Provide slack within maximums recommended by manufacturer.
- D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.6 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Make flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic-control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate

with connection to electrical equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing: Test pullout resistance of seismic anchorage devices.
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect'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 Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Record test results.

END OF SECTION 260548

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. Provide identification as specified herein for all indicated items.
- D. Work Included:
 - 1. Nameplates to identify disconnect switches, starting devices, control switches, pushbutton stations, panelboards.
 - 2. Wire tags at each end of all feeders and control wiring, and feeder wires only in all junction and pull boxes.
 - 3. Labels for exposed conduits, conduits containing feeders, fire alarm and communications.
 - 4. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms and enclosures.
 - 5. Provide OSHA, IEEE standard 1584, and NFPA-70E compliant Arc flash and shock hazard signage that indicates equipment voltage, all approach boundaries, incident energy levels, fault current levels available and PPE required for all electrical panelboards, safety switches, and transformers.

1.2 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
 - 1. Descriptive literature for materials specified.

1.3 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.6 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nameplates:

1. Nameplates shall be black core, white laminated Micarta having engraved letters.
2. Letter size and nomenclature shall be as directed by DOT or Amtrak.

B. Labels:

1. Labels on fire alarm conduits shall consist of "FA" stenciled in red letters on a white painted rectangular background, ¾" high lettering.
2. Labels on communication conduits shall be 2 blue bands painted, each 1-inch wide with 1 inch between them.
3. Wire tags shall be of adhesive backed cloth material with printed identifying numbers and letters which come in strips of individual characters to be wrapped around the conductor in sequence to comprise the identification. Nomenclature shall be as directed by client.
4. Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where larger size is needed for adequate vision.

5. The conduits of all feeders and branch circuits shall be properly designated at all panelboards, switches and other equipment by an approved round yellow plastic tag, of 0.040-inch minimum thickness and one inch in diameter, Actioncraft Products, or approved equal. The lettering shall be black, 1/8-inch high. No. 18 monel wire, doubled, shall be used to secure the tag. A list of tag descriptions shall be submitted to the Engineer for approval before any lettering is done.
6. All conduits within enclosures shall be properly identified by Seton Nameplate Corporation "Setmark" markers, Brady Snap-On Pipe Markers, or approved equal. The lettering and color coding of the markers shall be black on an orange background or in conformance with the latest revision of the ANSI Z53.1 Scheme for Identification of Piping Systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. All surfaces to receive labels shall be carefully prepared in accordance with the manufacturer's instructions.

3.2 APPLICATION

A. Labels:

1. Labels shall be painted and stenciled on clean dry surfaces.
2. All conduit systems shall require identification when exposed or concealed above accessible ceilings.

B. Nameplates:

1. Nameplates shall be secured to painted surface with suitable Torx Tamperproof stainless-steel screws, lockwashers and nuts.
2. Nameplates shall be secured to unpainted surfaces with epoxy cement. Surface shall be properly cleaned before application.

C. Danger Signs:

1. Danger signs shall be secured with Torx Tamperproof stainless-steel screws lock washers and nuts.

END OF SECTION 260553

SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 APPLICATION

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.

1.2 SUMMARY

- A. 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. The study shall include the entire electrical system for the facility.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. 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.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

- A. Submit the following in accordance with Standard Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

- B. In accordance with the General and Special Conditions, specific items requiring submittals are specified in each individual section of Division 26. Partial submittals are not acceptable; such submittals will be returned without review.
- C. Product Data: For computer software program to be used for studies.
- D. Other Action Submittals: Submit the following prior to the approval of system protective devices submittals. Submit three signed and sealed reports and 1 complete electronic copy including all computer files.
 - 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 Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Professional Engineer
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E or CSA Z462-12(2012).

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
- B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 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.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Software Developers: Subject to compliance with requirements, provide software by one of the following:
 - 1. Operation Technology, Inc. (ETAP)
 - 2. SKM Systems Analysis, Inc. (Power Tools for Windows)
- 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 "Power System Data" Article.
- 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 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.
 - 1. The entire electrical system both new and old shall be included in the study.
- D. 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.
- E. 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, ac systems.
- F. 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 PROTECTIVE DEVICE COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
 - 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 - 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.

3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141 and IEEE 242 recommendations for fault currents and time intervals. (Comply with NEC for selective coordination NFPA 70; 240.12, 700.27, 701.18)
- C. Transformer Primary Overcurrent Protective Devices:
1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.

- e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- F. Provide completed data sheets for setting of overcurrent protective devices bound in a 3 ring binder.

3.4 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 contribution from all sources is at a minimum and shall assume no motor load.
 2. The maximum calculation shall assume a maximum contribution from all sources 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. 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.
- F. 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).
- G. 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.

- H. 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.

3.5 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.
 - 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.

3.6 LABELING

- A. Apply one arc-flash label for 480-V ac, and applicable 120/208-V ac panelboards and disconnects and for each of the following locations:
 - 1. Switchboards.
 - 2. Panelboards.
 - 3. Control panels.

3.7 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.8 DEMONSTRATION

- A. 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 260800 – COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 GENERAL

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.
- C. All equipment furnished and installed under this Contract shall be tested as indicated in the Contract Drawings or as specified herein.
- D. The Contractor shall hire an independent NETA certified testing company to make such tests as may be necessary to demonstrate that the equipment, as installed, complies with the Contract requirements. He shall provide all labor, instruments and apparatus required for such tests. If any of the equipment fails, under test, to meet the Contract requirements or to function properly, the defects shall be rectified by readjusting or removing and replacing, the faulty equipment until, under test, the requirements are met. The Engineer reserves the right to check the Contractor's instruments or to furnish his own instruments.
- E. All tests shall be performed in conformity with the standard test codes of the applicable association(s) as specified in paragraph 1.2 FACTORY TESTS and shall be witnessed by the Engineer or his representative and by an authorized representative of the User Department.
- F. All measuring instruments shall be of the precision type and shall be calibrated immediately before and immediately after the tests. All instruments and other facilities, including labor, for the tests shall be provided by the Contractor. Client will furnish electrical energy to the Contractor without charge for making the tests.
- G. The Contractor shall furnish and install all necessary testing apparatus such as calibrated meters, gauges, fittings, thermometers, etc. All apparatus supplied by the Contractor for these tests shall remain his property and be removed by him after the tests.
- H. The Contractor shall submit test procedures for the approval of the Engineer, showing in complete detail the manner in which he proposes to perform each test.

- I. Contractor shall provide full documentation and certifications of all tests performed.

1.2 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

1.3 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.6 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

1.7 FACTORY TESTS

- A. All equipment, including machinery, apparatus and materials of construction, shall be tested at the places of manufacture.
- B. All service and distribution equipment, switchboards and panelboards shall be given a Hi-Pot test at the place of manufacture in accordance with the requirements of the latest edition of the National Electrical Code and witnessed by the Engineer or his authorized representative.
- C. All necessary ratings, capacities, calibration, temperature in operation and other characteristics shall be obtained by methods in accordance with the standard test codes of the applicable association, such as the American National Standards Institute, Underwriters Laboratories, the Institute of Electrical and Electronics Engineers. Six copies of these certified ratings, etc., shall be submitted for the approval of the Engineer. No material or apparatus shall be shipped to the work site unless approved by the Engineer.

1.8 FIELD TESTS

- A. Field tests shall be made on apparatus which is not assembled at the shop, such as electrical equipment, to demonstrate the soundness and suitability of the materials, and the adequacy of the craftsmanship of the installation work. In addition, performance tests shall be made on the plant as a whole, upon its major subdivisions and as required by the Engineer, in conformity with the standard test codes of the applicable association(s) as specified in Paragraph 1.2 FACTORY TESTS. All measuring instruments shall be of the precision type and shall be calibrated immediately before and immediately after the tests. All instruments and other facilities, including labor, for the tests shall be provided by the Contractor. The client will furnish to the Contractor, without charge, electrical energy for the tests.
- B. The Contractor shall furnish and install all necessary testing apparatus such as calibrated electrical meters, gauges, fittings, thermometers, etc. All the foregoing apparatus supplied by the Contractor for these tests shall remain his property and be removed by him after the tests.
- C. The Contractor shall submit, for the approval of the Engineer, test procedures showing in complete detail, the manner in which he proposes to perform each test.
- D. All defects in the new systems shall be corrected to the satisfaction of the Engineer. All equipment shall be retested after the correction of defects.
- E. The Contractor shall make insulation resistance and ground tests of all wiring installed under this Contract in conformity with the requirements of this Section and as elsewhere specified herein during the progress of the work, and at such time as the Engineer may desire. These tests shall be made previous to connection to equipment and in the presence of the Engineer.
- F. Apparatus such as circuit breakers, contactors, motor starters, push button stations, etc., shall be checked for free movement and alignment of parts and contacts.
- G. The ground fault protection system shall be performance tested, as required by the National Electrical Code, Article 230-95(c).
- H. The grounding system shall be tested and verified with accepted methods and standards by actual measurements in the field. The proposed method of measurement shall be submitted for approval. Unless otherwise specified grounding resistance shall not exceed 5 ohms. The resistance values and the soil conditions at the time measurements were made, along with location of each ground rod shall be submitted to the Engineer.
- I. A performance test shall be made to verify proper electrical operation of all power and control circuits and electrical apparatus.
- J. After installation performance tests shall be made on the station as a whole, upon its major subdivisions and as required by the Engineer. The tests shall be performed with all rated loads connected.

- K. Similar test shall be performed on the emergency equipment with all rated emergency loads connected.
- L. Motors shall be checked for proper rotation, and for balancing of the currents in all three phases.

1.9 ELECTRICAL TESTS AFTER INSTALLATION

- A. All electrical equipment, including wire and cable, shall be tested after completion of installation in accordance with the following specifications:
 - B. Wiring shall be installed so that when completed, the system will be free from shorts, crosses or grounds. All electrical feeders and other wire and cable prior to being connected as requested by the Engineer shall be subject to an insulation resistance test using a "megger" with the following D.C. voltages applied between the connected system and ground.
 - 1. 250 volt system - apply 500 volts
 - C. Insulation Resistance: All wiring shall be so installed that when completed, the system will be free from shorts or grounds.
 - D. The Contractor shall make such tests as may be necessary, including polarity test of the sockets, to demonstrate that the equipment, as installed, complies with the Contract requirements. He shall provide all labor, instruments and apparatus required for such tests. If any of the equipment fails, under test, to meet the Contract requirements or to function properly, the defects shall be rectified by readjusting, or removing and replacing, the faulty equipment until, under test, the requirements are met. The Engineer reserves the right to check the Contractor's instruments or to furnish his own instruments.

END OF SECTION 260800

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. General: Extent of lighting control system work is indicated on drawings and schedules.
- D. The extent of lighting control work includes, but is not limited to, the furnishing and installation of all lighting control components into complete and working lighting control systems as specified in this section, on the drawings, and as required by job conditions. System components include, but are not limited to:
 - a. Factory pre-assembled and pre-wired microprocessor controlled relay panels with electrically held, latched relay panels.
 - b. Control stations, including wall mounted low voltage remote controls.
 - c. Control system network low voltage wiring for interconnection of lighting control relay panels, remote switches and master control stations.
 - d. Digital Photosensor(s) for operation of selected circuits.
 - e. Interfaces to dimming systems.
 - f. Permanently installed terminal(s), Lighting Management Stations and master control stations for system programming and feedback.
 - g. Digital Time Clock (DTC)

1.02 DESIGN AND PERFORMANCE REQUIREMENTS

- A. The submission of a bid by the Contractor will be construed as evidence that a careful, complete and thorough examination of the premises, existing job conditions and Contract Documents has been made and later claims for labor, materials or equipment required or for difficulties encountered, which could have been foreseen had such an examination been made, will not be recognized. It shall also constitute a representation that the Contractor has checked and verified all quantities, work and materials involved and shall take complete responsibility for any deficiencies encountered thereafter.
- B. The Contractor shall insure that the lighting control system manufacturer shall keep on file and make available for review by the Engineer and the Authority complete Quality Control and Quality Assurance records for all phases of production for all lighting equipment to be supplied under this project.
- C. Upon request the Contractor shall submit for review by the Engineer and the Authority verification that he has solicited pricing from all manufacturers which have been listed as "prime spec" and "approved equal." Upon request the Contractor shall submit for review itemized (line item) unit equipment costs for all equipment to be provided under the Scope of this Contract.
- D. The Contractor shall be solely responsible for coordinating and expediting the timely procurement and delivery for the lighting control system, equipment and related components for the project.
- E. Specifications and drawings are intended to convey the salient features, function and character of the control system only, and do not undertake to illustrate or set forth every item or detail necessary for the work. Minor details not usually indicated on the drawings nor specified, but that are necessary or normally required for the proper execution, completion, installation and operation of the control systems shall be included, the same as if they were herein specified or indicated on the drawings.
- F. Omissions: The full and complete responsibility for accurately fabricating the control systems described herein to the fulfillment of those specifications shall rest solely with the Contractor.

1.03 RELATED SECTIONS

- A. Contract Documents: Drawings and General and Special provisions of the Contract, including bidding requirements, General Conditions, General Requirements of the Specifications apply to work of this section.
- B. Related Sections: Refer to other sections of Division 26 for the following:
 - a. 260553 - Identification for Electrical Systems.
 - b. 260519 - Low Voltage Electrical Power Conductors and Cables.
 - c. 265200 - Emergency Lighting
 - d. 262726 - Wiring Devices
 - e. 265600 - Lighting

1.04 REFERENCES

- A. American National Standards Institute (ANSI)
 - a. C2 - National Electrical Safety Code
- B. ASTM International (ASTM)
- C. Illuminating Engineering Society of North America (IESNA)
- D. National Equipment Manufacturers Association (NEMA)
 - a. WD6 - Wiring devices – Dimensional requirements
 - b. OD3 - Physical and electrical interchangeability of photo control devices and mating receptacles
- E. National Fire Protection Association (NFPA)
 - a. 70 - National Electric Code
 - b. 101 - Life Safety Code
- F. Underwriters Laboratories (UL)
- G. Occupation Safety and Health Administration (OSHA)
 - a. The Energy Policy of 1992: Lamp Efficiency Labeling and Standards
 - b. The Energy Policy of 2005: Lamp Efficiency Labeling and Standards
- H. Applicability of Standards:
 - a. Except where more explicit or stringent requirements are written into the Contract Documents, applicable construction industry standards have the same force and effect as if found in or copied

- directly into the Contract Documents. Such industry standards are made a part of the Contract Documents by reference.
- b. Referenced standards (standards referenced directly in the contract documents) take precedence over standards that are not referenced but generally recognized in the industry for applicability to the work.
 - c. Unreferenced standards are not directly applicable to the work, except as a general requirement of whether the work complies with recognized construction industry standards.
- I. Publication Dates: Except as otherwise indicated, where compliance with an industry standard is required, comply with the latest standard in effect as of date of Contract Documents.
 - J. Conflicting Requirements: Where compliance with two or more standards or criteria is specified and where these standards establish different or conflicting requirements for minimum quantities or performance quality levels, the most stringent requirement will be enforced, and henceforth provided by the Contractor unless the Contract Documents specifically indicate otherwise. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent, to the Engineer for a decision before proceeding
 - K. Minimum Quantities or Quality Levels: In every instance the quantity or quality level shown or specified is intended to be the minimum to be provided or performed. Unless otherwise indicated, the actual work may either comply exactly, within specified tolerances, with the minimum quantity or quality specified, or may exceed that minimum within reasonable limits. In complying with these requirements, the indicated numeric values are minimum or maximum values, as noted or as appropriate for the context of the requirements. Refer instances of uncertainly to the Engineer for a decision before proceeding.
 - L. Copies of Standards:
 - a. The Contract Documents require that each entity performing work be experienced in that part of the work being performed. Each entity is also required to be familiar with industry standards applicable to that part of the work. Copies of applicable standards are not bound with the Contract Documents.
 - b. Where copies of standards are needed for proper performance of the work the Contractor is required to obtain such copies directly from the publication source.
 - c. Although copies of standards needed for enforcement of requirements may be required submittals, the Engineer reserves the

right to require the Contractor to submit additional copies as necessary for enforcement of requirements.

1.05 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. All lighting control systems, components and sub-components shall be manufactured, furnished and installed in compliance with all government agencies having jurisdiction. All fixtures shall bear the appropriate UL (or ETL) and IBEW identifications. Panelboards and integral Lighting Control Chassis are to be UL listed under UL 916 Energy Management Equipment, UL 67 Panelboard Interiors and UL 5 panelboard box. Lighting control panels controlling emergency circuits shall be ETL listed to UL 924.
- C. Manufacturers: Provide products of firms regularly engaged in the manufacture of lighting control equipment of the types and ratings whose products have been in satisfactory use in similar service for not less than ten years.
- D. National Fire Protection Association (NFPA): Comply with NFPA 70, "National Electrical Code," 2017 as applicable to construction and installation of interior building lighting fixtures and emergency lighting.
- E. Regulatory Requirements: Cabinets and all related components and subsystems shall comply with the following regulatory requirements:
 - a. National Electric Code 2017 (NEC)
 - b. National Electrical Manufacturer's Association (NEMA)
 - c. Underwriter's Laboratories, Inc. (UL) or (ETL)
 - d. Any local jurisdictional codes
- F. Materials and equipment, as well as workmanship, shall conform to the highest commercial standards and shall be as specified and/or as indicated on the drawings. Parts not specifically identified shall be made of materials most appropriate for their intended use.
- G. Manufacturers: Manufacturers shall be assumed capable of supplying the listed systems unless clearly written exceptions are set forth in their quotations. Any such exceptions shall immediately be brought to the attention of the Engineer. Manufacturers not listed (as prime or approved equal) must comply with the following:

- a. Experience: Manufacturers shall have not less than ten years experience in design and manufacturing of lighting control equipment of the type and quality shown. Submission must include a list of completed projects and dated catalogue pages or drawings indicating length of experience.
 - b. Samples: Manufacturers shall submit a prototype sample of each panel and control equipment for review by the Engineer. Prototype samples shall be sufficiently detailed and operational to allow evaluation of compliance with the salient features of the specification. Preliminary design or shop drawings shall not be accepted in place of prototype samples (see Section 1.08).
- H. All major system components shall be manufactured and supplied by one company.
- I. All components and assemblies are to be factory pre-tested and burned-in as a system for 48 hours prior to installation.

1.06 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: Submit manufacturer's data on panels, communication devices and controllers.
- C. Shop Drawings: Submit dimensioned drawings of control system components. Submit shop drawings with proposed component and accessories clearly indicated on each sheet. Shop drawings must be submitted for review before fabrication. Shop drawings shall indicate the exact location of each device.
- D. One Line Diagram: Submit a One Line Diagram of the Lighting Control System, indicating every component in the system and the type, size and number of conductors between each component. Submittals that show typical rise diagrams are not acceptable.
- E. Manuals: Prior to final inspection, provide complete set of operating and maintenance manuals. Include technical data sheets and parts ordering information. Include testing and maintenance requirements and instructions for emergency transfer components.
- F. Shop drawings shall be submitted in reproducible form. Fixture fabrication details shall be drawn at either full size or half size scale.

Fabrication details shall illustrate a minimum of three critical views indicating all fabrication and assembly methods, materials, material gauges and finishes to be employed.

- G. Catalogue submittals lacking sufficient detail to indicate compliance with contract documents shall not be acceptable.
- H. "Approved Equal" specification status does not and shall not exempt the identified manufacturers from full and complete compliance with all criteria identified either in the specifications or as attributed to "prime specification" equipment with regards to performance, control capability, size finishes, etc. Consideration, acceptance or rejection of any proposed submittal at any time shall rest solely upon the evaluation of the Lighting Designer for those areas within the project scope. The control system shall be compatible with all selected light fixtures.

1.07 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.09 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information
- B. The entire lighting control system shall carry a warranty for one year from date of start-up after final written acceptance by the Authority.
- C. For the duration of the warranty the control system manufacturer shall provide 24-hour, 7-day emergency service contact with trained factory personnel. Maximum acceptable response time to a call for service shall be 12 hours. At the end of the warranty period, the manufacturer shall submit to the Authority a proposal for a continued maintenance contract for the entire control system.

- D. The manufacturer of the control system shall guarantee that replacement parts for all new components shall be available for a minimum of seven years after the system's installation and acceptance by the Authority.
- E. At the time of Bid Submission each manufacturer shall submit for review and approval the name of the person/persons or agency who will be charged with the responsibility of fulfilling the manufacturer's field service obligations for the life of the warranty.
- F. Warranty shall ensure that the Lighting Control System manufactured and supplied will be the kind and quality described in the specification and will be free of defects in workmanship and material.

1.10 SAMPLES

- A. Upon request, submit for review one representative sample of each lighting control component required under this Contract. After sample acceptance, the control equipment shall be sent to the project for use as a standard. In the event the submission is rejected, the control component will be returned to the manufacturer who shall immediately make a new submission which meets the contract requirements.
- B. Shipping: The samples must be actual working devices to be supplied and shall be submitted complete, ready for energizing and examining and shall be shipped (prepaid) to the Engineer or as otherwise specified or directed.

1.11 SUBSTITUTIONS

- A. Equipment included under this section is specified by approved manufacturer, type, function to establish minimum standards of quality for bidding. Furnish equipment as specified unless substitutions are agreed upon as follows:
 - a. Submit a written Request for Substitution of Specified Equipment to the Construction Manager at least two weeks prior to bid date. Make the request an Alternate, separate proposal accompanied by complete descriptive and technical data in comparison to the "Accepted" manufacturers. Show cost comparison of "Accepted" manufacturer's equipment to the proposed substitution. Substitutions proposed less than two weeks prior to bid date, or not including proper documentation will not be considered.
 - b. Where proposed substitutions will alter the functional or visual design, or change the space requirements from those shown in the

- drawings, detail such changes in the proposal and include costs for revised design and construction for all trades involved.
- c. No requested for substitutions will be considered more than ninety days after the contract is awarded.
 - d. If equipment to be supplied, including that supplied by approved manufacturers, meets the broad scope requirements of the drawings and specifications, but differed in some details, bring such differences to the Authority's attention and obtain a written interpretation before submitting the bid, or proceeding with the work. Otherwise no variations or differences are permitted.
 - e. The Engineer approve/disapprove any requests for substitution.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

The approved manufacturer is shown below:

1. Acuity Brand/Lighting Control and Design
Or
2. Approved equal.

2.02 NETWORKABLE LIGHTING CONTROL SYSTEM DESCRIPTION

- A. The lighting control system shall be a networked system that communicates via RS485. The system must be able to communicate with fully digital centralized relay panels, local relay panels, SO breaker panels, digital switches, photocells, various interfaces and shall include all operational software. The intent of the specification is to integrate all lighting control into one system, except for areas controlled by a single motion sensor such as some non-public rooms and emergency fixtures designed to operate 24/7. Distributed lighting control shall be provided using networked lighting relay panels. Centralized relay panels shall control the station lighting and site lighting. Lighting control system shall include all hardware and software. Software shall be resident within the lighting control system. System shall provide local access to all programming functions at the master Lighting Control Panel (LCP) and remote access to all programming functions via dial up. Lighting control system shall have server built into the master LCP that "serves" HTML pages to any authorized workstation.
- B. System software shall provide real time status of each relay, each zone and each group.

- C. Lighting control system shall be able to be monitored by and take commands from a remote PC. At any time, should the remote PC go off-line all system programming uploaded to the lighting control system shall continue to operate as intended. Systems requiring an on-line PC or server for normal operation are not acceptable.
- D. All devices shall be pre-addressed at the factory. Field addressing is not acceptable.
- E. All programs, schedules, time of day, etc, shall be held in non-volatile memory for a minimum of 10 years at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.
- F. System shall be capable of flashing lights Off/On any relay or any zone prior to the lights being turned Off. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled Off sweep using local wall switches within the occupied space. Occupant override time shall be locally and remotely programmable and not exceed 2-hours.
- G. The system shall be capable of implementing On commands, Off commands, Raise (dimming) commands, Lower (dimming) commands for any relay, group or zone by means of digital wall switches, specification grade line voltage type wall switches, photocell, web based software or other devices connected to programmable inputs in a lighting control panel.
- H. The Lighting Control System shall provide the ability to control each relay and each relay group per this specifications requirement. All programming and scheduling shall be able to be done locally at the master LCP and remotely via dial up modem and via the Internet. Remote connection to the lighting control system shall provide real time control and real time feedback.
- I. System shall consist of centralized relay panels, local relay panels, Solenoid Operated (SO) breaker panels, digital switches, photocells and various digital interfaces. Verify exact components specified. Local relay panels, SO breaker panels, centralized relay panels and digital switches shall communicate as one network via RS485. Local relay panels, mounted in each local area, per plans shall control all lighting fixtures in that space, provide power to occupancy sensors and take input from daylight sensor and occupancy sensors. Local relay panels shall be capable of taking inputs from standard, line voltage type switches and outputting up to 8 independent 0v to 10v dimming signals. All local relay panels and all devices connected to local relay panels (switches, photocells and occupancy sensors, etc) shall be wired per lighting control manufacturers instructions.

2.03 MATERIALS AND COMPONENTS

A. RELAY PANELS

1. NEMA rated enclosures with screw cover or hinged door. Other NEMA enclosure types will be optional.
2. Lighting Control Panels (LCP) input power shall be capable of accepting 120/208V or 277V without rewiring.
3. Control electronics in the low voltage section shall be capable of driving 2 to 48, 30 Amp, 18,000 SCCR rated latching relays, control any individual or group of relays, provide individual relay overrides, provide a master override for each panel, store all programming in non-volatile memory, after power is restored return system to current state, provide programmable blink warn timers for each relay and every zone, and be able to control relays that default to Open, Normally Open Latching (NOL) or relays that default to Closed, Normally Closed Latching (NCL).
4. Lighting control system shall be digital and consist of a Master LCP, Slave LCPs, Local LCPs with up to 8 individual relays, digital switches, digital interface cards and if required, SO breaker panels. All system components shall connect and be controlled via a single Category 5, 4 twisted pair cable with RJ45 connectors, providing real time two-way communication with each system component. Analog systems are not acceptable.
5. The lighting control system shall be a networked system that communicates via RS485 and includes centralized relay panels, local relay panels, digital switches, photocells, various interfaces and operational software. The intent of the specification is to integrate all lighting control into one system. Lighting control system shall include all hardware and software. Software to be resident within the lighting control system. System shall provide local access to all programming functions at the DTC and remote access to all programming functions via dial up modem. Lighting control system shall have server built into the master LCP that "serves" HTML pages to any authorized workstation.

B. LOCAL RELAY PANELS

1. Local relay panels shall have up to 8-30 Amp, 18,000 Short Circuit Rating (SCCR) rated lighting relays and shall control all lighting in the designated area indicated on the plans and be networked to centralized relay panels, local relay panels, SO breaker panels, digital switches, photocells, various interfaces. Each local relay panel shall provide minimum 300ma at

12/24vdc for powering occupancy sensors. Local relay panels that require a separate occupancy sensor power pack are not acceptable.

2. Local relay panel shall provide a minimum 4-programmable photocell inputs, a minimum 4-programmable occupancy sensor inputs and matrixed contact closure inputs. This requirement is to insure integration of entire lighting system into one networked, lighting control system.
3. Local relay panels shall be capable of outputting minimum 4 and up to 8 independent 0v to 10v dimming signals, one independent dimming signal at each of 8 relays. In order to maximize daylight harvesting and minimize disruption to occupants, each dimming output shall provide adjustment for baseline, start point, mid point, end point, trim, fade up rate, fade down rate, time delay and enable/disable masking. All photocell setting must be remotely accessible. Systems providing On, Off with Time Delay only, and system that do not provide remote access are not acceptable.

C. STANDARD OUTPUT RELAYS

1. UL Listed 30 Amp, Latching, 18,000 SCCR, 277VAC Ballast and HID and 20 Amp Tungsten at 120 Vac.
2. Relays shall be individually replaceable. Relay terminal blocks shall be capable of accepting two (2) #8AWG wires on both the line and the load side. Systems that do not allow for individual relay replacement or additions are not acceptable.
3. Relays to be rated for 250,000 operations minimum at a full 30 Amp lighting load, default to closed at normal power loss, Normally Closed Latching (NCL). All incandescent circuits shall be energized by use of a Normally Closed Soft Start relay rated at 100,000 operations at full 20 Amp load. No exceptions.
4. Optional relay types available shall include: Normally Open Latching (NOL) relay rated for 250,000 operations, a 600v 2-pole NO and NC and a Single Pole, Double Throw (SPDT) relay.

D. LOW VOLTAGE SWITCHES

1. All switches shall be digital and communicate via RS 485. Contact closure style switches, except as specified for connection to the local relay panel matrixed contact closure inputs, shall not be acceptable. The programming for a digital switch will reside in the switch itself, via double EPROM

memory. Any digital switch button function shall be able to be changed locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet.

2. Digital low voltage switch shall be a device that sits on the lighting control system bus. Digital switch shall connect to the system bus using the same cable and connection method required for relay panels. System shall provide capability to locally and remotely program each individual switch button, monitor and change function of each button locally and remotely. Each button shall be capable of being programmed for On only, Off only, On/Off (toggle), Raise (Dim up) and Lower (Dim down). Switches requiring low voltage control wires to be moved from one input terminal to another to accomplish these functions are not acceptable.
3. Keyed switches shall be programmable and connect to the lighting controls system bus.
4. Digital switches for high abuse areas (public areas, etc.) shall be vandal resistant, contain no moving parts, and be touch sensitive and available with up to three buttons in a single gang. Multi gang versions shall also be available. Touch pads shall be Stainless Steel and capable of handling both high abuse and wash down locations. High abuse switches shall connect to the lighting control system digital bus. Each high abuse switch touch button shall be able to be control any relay or any group in any panel or panels that is part of the lighting control system. Each touch button shall be able to be programmed for On, Off, Toggle or Maintain operation. All programming shall be done locally or remotely via dial up modem; or web interface as described in other paragraphs of this section. High abuse switches shall be able to be enabled or disabled digitally. Each touch pad is to be identified as to function by an engraved label. Switches must be capable of handling electrostatic discharges of at least 30,000 volts (1cmspark) without any interruption or failure in operation.

E. DTC – DIGITAL ELECTRONIC TIME CLOCK

1. A Digital Time Clock (DTC) shall control and program the entire lighting control system and supply all time functions and accept interface inputs. DTC shall be capable of up to 32 schedules. Each schedule shall consist of one set of On and Off times per day for each day of the week and for each of two holiday lists. The schedules shall apply to any individual relay or group of relays.

2. The DTC shall be capable of controlling up to 126 digital devices on a single bus and capable of interfacing digitally with other individual buses using manufacturer supplied interface cards.
3. The DTC shall accept control locally using built in button prompts and use of a 8 line 21-letter display or from a computer or modem via an on-board RS 232 port. All commands shall be in plain English. Help pages shall display on the DTC screen.
4. The DTC shall be run from non-volatile memory so that all system programming and real time clock functions are maintained for a minimum of 15 years with loss of power.
5. Pre-installed Unity™ lighting control software provides a visual representation of each device on the bus, show real time status and the ability to change the status of any individual device, relay or zone. System shall be capable of running optional Unity GX lighting control software, which shall provide for directly importing vector based graphics.
6. Pre-Installed modem allows for remote programming from any location using a PC. Modem to include all necessary software for local or remote control.
DTC shall provide system wide timed overrides. Any relay, group or zone that is overridden On, before or after hours, shall automatically be swept Off by the DTC a maximum of 2 hours later.

F PHOTOCELL: Photocells shall be mounted in location indicated on the plans. Photocells used for exterior lights shall provide multiple trips point from 1 roof mounted unit. All trips points shall be able to be changed remotely via Internet or dial up modem. Photocells requiring manual trip point adjustment are not acceptable. Photocell used for interior lighting control shall have multiple settings such as start-point, mid-point, off-point, fade-up, fade-down, etc. All settings shall be remotely accessible and adjustable. Systems providing local adjustment only are not acceptable. Photocells to be certified to comply with the current energy code covering this project at time of submittal of plans for building permit.

G INTERFACES: For future expansion capability, system to have available all of the following interfaces. Verify and install only those interfaces indicated on the plans

1. A dry contact input interface card that provides 14 programmable dry contact closure inputs. Use shielded cable to connect input devices to interface card.

2. Interface card providing digital communication from one system bus to another system bus, allowing up to 12,000 devices to communicate.
3. Interface cards shall allow the DTC to control up to 32 digital XCI brand thermostats. Programming of thermostats shall be able to done locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet
4. Voice prompted telephone override interface modules shall be provided. Interface module shall accept up to 3 phone lines and allow up to 3 simultaneous phone calls. Voice prompted menu and up to 999 unique pass codes shall be standard with each interface module.
5. Software pre-installed to run Graphical Interface Software. The software shall provide via local or remote PC a visual representation of a specific area or the total area of the project. Full graphic pages shall be designed to the Authority's requirements.
6. Direct digital interface to SO Breaker panelboards shall be available. Relay panel and SO Breaker panelboards circuits shall appear on the system software as similar, yet distinct, items and maintain all functions and features of the system software.
7. Direct digital interface to DMX 512 based systems. DMX interface shall provide 14 global commands, each of which can be modified locally or remotely using lighting controls manufacturer supplied software. DMX interface shall be integral to the system bus and shall connect and be controlled via a single Category 5, 4 twisted pair cable, providing real time response from the lighting control system to DMX commands.
8. Direct digital interface to building automation systems using DDC protocols such as BACnet, Metasys (N2) and ModBus that accept on/off commands, time schedules and report status of all relays in all panels in real time. Interface cards shall "self populate" each individual relay and each group to the BAS. All BAS system programming required shall be the responsibility of the BAS system provider.

H. OCCUPANCY SENSORS:
Not required

PART 3- INSTALLATION

3.01 INSTALLATION

- A Delivery Storage Handling:** Deliver products to the job site in manufacturer's original containers marked with job name, Contractor's name and labeling that

clearly indicates the contents. Deliver, store and handle products in accordance with manufacturer's written admonishments.

- B. Job Conditions: Maintain job site conditions in accordance with manufacturer's recommendations.
- C. Reject and do not install any damaged or unsatisfactory equipment. Replace unsatisfactory equipment with new equipment that is satisfactory if so directed by the Authority or their representative.
- D. The system shall be installed utilizing complete manufacturer's shop drawings and in accordance with these specifications.
- E. Install Control Stations only after "wet" work such as plastering and painting is complete and the area is cleaned.
- F. The breaker cabinets and controls shall be stored in their original cartons or crates in a dry location free from dirt and dust until ready to install. Provide protection and protective coverings as appropriate to prevent damage to the equipment during installation and until Authority's acceptance. Repair or replace damaged equipment as directed.
- G. Mount equipment at locations and heights indicated on approved shop drawings, or as directed by Authority. Locations indicated on the electrical drawings are general and approximate - carefully verify locations with Engineer's plans prior to installation. Check for adequacy of headroom and clearance with other equipment such as ducts, pipes and openings. The installing contractor shall bring all conflicts to the Authority's attention prior to proceeding with the work.
- H. Upon completion of the installation Contractor shall test all line voltage and control wiring for continuity and accuracy of all connections.
- I. Upon completion of the installation, the lighting control equipment shall operate per specifications and be free from defects in condition and finish. Moveable parts must operate freely and with uniform friction throughout their range. Any components damaged prior to the final inspection must be replaced by the Contractor prior to inspection.
- J. Contractor shall ensure that the factory start up engineer makes any calibrations and adjustments necessary for proper operation of the system.

3.02 SYSTEM START-UP

- K. Upon completion of the installation, the system shall be checked out and started up by a factory trained technician. Contractor to have completed and tested all wiring, installed all controls and lamped all fixtures before start up.

- L. Upon completion of system start up, the factory trained technician shall demonstrate the operation of the system to the Contractor and the Authority's representative. Contractor to advise Authority's representative prior to scheduling start up so all persons designated by the Authority and Engineer are present for training. [See Sect. 3.03] The following system start-up services shall be supplied by a factory trained Technician during a single site visit.
 - a. Check installation of all Lighting Control Panelboards
 - b. Test operation of all Breakers and Lighting Breakers
 - c. Test operation of all Low Voltage Inputs
 - d. Test operation of all Telephone Override Lines
 - e. Test operation of all Network Communication
 - f. Test operation of the Associated Printers
 - g. Load Application Specific software Control Modules and test operation
 - h. Repair or replace any defective component
 - i. Test operation of the complete Lighting Management System

- M. Equipment manufacturer to provide four bound copies of a "Maintenance and Operation Manual" to the Authority's representative. Manuals shall contain "As Built" shop drawings, wiring diagrams, description of all control functions, all instruction sheets for all components, calibration and adjustment procedures for all applicable components, maintenance procedures and instructions, component specifications, copy of warranty and service contract (if applicable), address and phone contacts for troubleshooting and service help. Manufacturer's start up engineer to review contents of manual with Authority's representative.

- N. The Authority or his representative will schedule a final inspection with the Contractor. The Contractor will make any necessary adjustments and calibrations, whether the inspection is scheduled within or outside normal working hours, at no additional cost to the Authority.

- O. If deficiencies that can be corrected immediately are apparent, correct them as soon as possible and schedule another final inspection with the Authority. The Contractor will reimburse the Engineer or his representative for his costs, including travel costs, to return for re-inspection. The Contractor will also bear costs of any additional

inspections until the system is approved of system. System must be approved prior to Authority's acceptance.

3.03 TRAINING

- A. Factory technician will schedule, in coordination with the Authority, a training period for the Authority's staff [minimum five personnel] or designated appointees. This training period to be a minimum of three hours. Training to encompass entire scope of the system including operation, adjustments, maintenance and troubleshooting until completely understood. Manufacturer shall submit names and period of attendance of those instructed.
- B. The following system training services shall be supplied by a factory Field Engineer during a single site visit:
 - a. System review of all Hardware Components and their functions
 - b. System review of all software Components and their function
 - c. Hands-On "Operator" training to develop experience with Supplied Control Functions
 - d. Hands-On "Building Engineer" training to develop experience with system Software Programming
 - e. Walk through of User's Guide and Programmer's Guide

3.04 SYSTEM PROGRAMMING

- A. The following system programming services shall be supplied by a factory Field Engineer during a single site visit:
 - a. Advise the Building Engineer on developing a control scenario for each application
 - b. Program the Building Engineer supplied control scenario into the Lighting Management System
 - c. Review the programmed information with the Building Engineer and walk through the operation of the program
 - d. Provide program on a CD.

3.05 DOCUMENTATION

- A. The following documentation shall be supplied:
 - a. System Single-Line Diagram: show system components and quantities including panelboards, breakers, low-voltage switches and sensors, dataline, telephone override lines and Lighting or Building Management Station.

- b. Panelboard Configuration Diagram: Show PC board configuration, breaker configuration and power supply location.
- c. Panelboard Wiring Schedule: Show breaker/load relationship with direct switch override if applicable.
- d. Wiring Diagram: Show typical wiring application diagram for each system component supplied.
- e. Installation Guide: Provide instructions as to how to install system components.
- f. Manual: Provide User's Guide and Programmer's Guide in a loose leaf three ring binder with step by step illustrated instructions.
- g. Riser Diagram: Provided by specifier along with reflected ceiling plans showing control schematic.

END OF SECTION 260923

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY:

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.

- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.

- C. Section Includes:
 - Low Voltage Transformers.

- D. This Section includes dry-type distribution transformers rated 600 V and less, with capacities up to 1000 kVA

- E. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

- F. 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.

1.2 INFORMATIONAL SUBMITTALS

- 1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
-
- A. Qualification Data: For testing agency.

- B. Source quality-control test reports.
- C. Field quality-control test reports.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.
- B. Manufacturer shall provide copies of following documents to owner for review and evaluation:
 - 1. Product data and spare parts list.

1.4 QUALITY ASSURANCE

- A. Testing Qualifications: Engage manufacturer with the experience and capability to conduct the testing to NETA standards.
- B. Source Limitations: Obtain each transformer type 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 C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton
 - 2. Square D Co./Schneider Electric.
 - 3. Approved equal

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Copper unless otherwise specified.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Indoor Transformer Enclosure: Ventilated, NEMA 250, Type 2.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Outdoor Transformer Enclosure: Totally enclosed, nonventilated, NEMA 250, Type 4X, stainless steel
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- E. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: ANSI 61 gray.
- F. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.

- G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- I. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- J. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.
- K. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor.
 - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 - 2. Indicate value of K-factor on transformer nameplate.
- L. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
 - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
 - 2. Include special terminal for grounding the shield.
 - 3. Shield Effectiveness:
 - a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
 - b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
 - c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.
- M. For wall mounted transformers provide wall brackets: Manufacturer's standard brackets.
- N. For tropical or sub tropic environments, provide fungus proofing, permanent fungicidal treatment for coil and core.
- O. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.
- P. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:

1. 9 kVA and Less: <40 dBA
2. 30 to 50 kVA: <45 dBA
3. 51 to 150 kVA: <50 dBA
4. 151 to 300 kVA: <55 dBA
5. 301 to 500 kVA: <60 dBA
6. 501 to 750 kVA: <62 dBA
7. 751 to 1000 kVA: <64 dBA

2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met..
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions Section 260548.16 "Seismic Controls for Electrical Systems.", and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. 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.
- B. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.
- C. Adjust all access doors and operating handles for free mechanical operation as described in manufacturer's instructions.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.
- B. Repaint scratched or marred exterior surfaces to match original finish.

END OF SECTION 262200

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY:

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. Section Includes:
 - 1. Distribution panelboards for station and platforms.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS:

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor or SDP: Surge Protection Device

1.4 PERFORMANCE REQUIREMENTS:

- A. Seismic Performance: Panelboards 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.

1.5 SUBMITTALS:

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- C. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
- D. Qualification Data: For qualified testing agency.
- E. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 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.
- F. Field Quality-Control Reports:
 - 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.
- G. Panelboard Schedules: For installation in panelboards.

- H. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Standard Form 817 include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 CLOSEOUT SUBMITTALS:

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 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 products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- 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.

1.8 DELIVERY, STORAGE, AND HANDLING:

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information
- B. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- C. Handle and prepare panelboards for installation according to NEMA PB 1.

1.9 PROJECT CONDITIONS:

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F
 - b. Altitude: Not exceeding 6600 feet

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet

1.10 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, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.11 WARRANTY:

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

1.12 EXTRA MATERIALS:

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS:

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 5. Finishes:
 - a. Panels and Trim: Galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
 - 6. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Compression type.
 3. Ground Lugs and Bus-Configured Terminators: Compression type.
- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals, contractor to submit short circuit calculations after selecting equipment.

2.2 DISTRIBUTION PANELBOARDS:

Manufacturers:

1. Eaton Cutler-Hammer
Or
 2. Approved equal.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: MCCB
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- F. Branch Overcurrent Protective Devices: MCCB.
- G. Install TVSS (or SDP) in all panels

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS:

- A. Manufacturers:
1. Eaton Cutler-Hammer
Or
 2. Approved equal
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

- F. Install TVSS (or SPD) in all panels

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES:

A. Manufacturers:

1. Eaton Cutler-Hammer
2. Or
3. Approved equal.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Molded-Case Circuit-Breaker (MCCB) shall be bolt-on type.
Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. All MCCB

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Equipment Mounting: Install freestanding panelboards on concrete bases, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in 260548 "Vibration and Seismic Controls for Electrical Systems."
- E. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.

- H. Install filler plates in unused spaces.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- J. Comply with NECA 1.

3.3 IDENTIFICATION:

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with Division 26 Section 260553 "Identification for Electrical Systems."

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. 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.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, 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, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

- b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
- 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.

3.5 ADJUSTING:

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

- 1. Measure as directed during period of normal system loading.
- 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
- 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
- 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION:

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Snap switches.
 - 3. Wall-switches.
 - 4. Contactors.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.
- D. Samples: One for each type of device and wall plate specified, in each color specified.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: Wiring device manufacturers' packing label warnings and instruction manuals to be included.

1.5 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70-2005, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70-2005.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.8 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

PART 2 - PRODUCTS

2.1 BUY AMERICA COMPLIANCE

- A. Products must meet Buy America requirements. Refer to NOTICE TO CONTRACTOR – BUY AMERICA for additional information.

2.2 MANUFACTURERS

- A. Manufacturers' Names:
 - 1. Cooper Industries, Inc.
Or
 - 2. Approved equal.

2.3 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5352 (duplex).
or
 - b. Approved equal

2.4 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper;
or
 - b. Approved equal

2.5 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper;
 - or
 - b. Approved equal
- C. Key-Operated Switches, 120/277 V, 20 A:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper;
 - or
 - b. Approved equal
 - 3. Description: Single pole, with factory-supplied key in lieu of switch handle.
- D. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper;
 - or
 - b. Approved equal

2.6 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Satin-finished stainless steel
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant equal to Pass & Seymour WICU-10.

2.7 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: Ivory, unless otherwise indicated or required.

2.8 LIGHTING SWITCHES

- A. Lighting control switches shall be furnished and installed as shown on the Contract Drawings.
- B. Unless otherwise indicated on the Contract Drawings, the boxes for the switches shall be provided with cadmium plated sheet steel cover plates, Crouse-Hinds Co. Cat. No. DS32, or approved equal, for surface mounted boxes and Crouse-Hinds Co. Cat. No. DSS32, or approved equal, for flush mounted boxes.
- C. Toggle Switches: UL standard 20, totally enclosed with bodies of thermosetting plastic and a mounting strap. Handles shall be ivory. Wiring terminals shall be of the screw type, back or side wired. Switches shall be rated quiet type with the number of poles, and other features indicated.
- D. Pilot lights shall consist of yoke-mounted, candelabra-base sockets rated at 75 watt, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green and jewels for other purposes shall be white.
- E. Lighting Contactors: Lighting contractors to be Square D Company or approved equal, Type S Series with NEMA I enclosure with hand-off auto selector switches.
- F. All switches shall be mounted four feet above the finished floor, unless otherwise indicated on the Contract Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Light switches shall be mounted 48 inches above finished floor to centerline. Fire alarm pull stations shall be mounted 48 inches above finished floor to operating handle.
- H. Receptacles, in general, shall be mounted 24 inches above finished floor except where unable, due to obstructions; receptacles may be mounted at a minimum of 18 inches above finished floor. Receptacles in the same room, space or area are required to be at the same elevation.
- I. Heights given are from finished floor to centerline of outlet or devices

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. This section specifies the furnishing and installation of safety switches complete in place.

1.2 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
 - 1. Manufacturer's catalog sheets for products should be included in this section.

1.3 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.6 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

PART 2 - PRODUCTS

2.1 SAFETY SWITCHES

- A. Safety type disconnecting switches shall be Type "HD", heavy duty, Class 3, Design 3, unless otherwise indicated, mounted in NEMA I enclosures. Enclosures exposed to wet or rain conditions shall be NEMA 4X stainless steel, water tight. Switches shall be rated at 600 minimum volts or as required by the voltage of the circuit on which they are utilized. They shall be rated in horsepower, and each shall be capable of interrupting the locked rotor current of the motor for which it is to be used, which current will be assumed as ten (10) times the full rated load current.
- B. The switches shall be of the quick-make, quick-break type, and all parts shall be mounted on insulating bases to permit replacement of any part from the front of the switch. All current-carrying parts shall be of high-conductivity copper, designed to carry rated load without excessive heating. Switch contacts shall be silver-tungsten type or plated to prevent corrosion, pitting and oxidation and to assure suitable conductivity. The switch operating mechanism shall be designed to retain its effectiveness with continuous use at rated capacity without the use of auxiliary springs in the current path.
- C. Safety switches located at motors and which are used as disconnects for maintenance only, shall be unfused and capable of being locked in the open position.

D. Accessories:

1. Equipment ground kit, internally-mounted and labeled for copper and aluminum.
2. Auxiliary contact kit.

2.2 MOLDED-CASE CIRCUIT BREAKERS

B. 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. Eaton Cutler-Hammer
Or
2. Approved equal

C. General Requirements: Bolt-on, Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

D. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

E. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

F. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
4. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
5. Auxiliary Contacts: Two SPDT switches] with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.3 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 4X stainless steel.

2.4 NAMEPLATES

- A. Standard phenolic nameplates with 3/8 inch minimum size lettering engraved thereon.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

END OF SECTION 262816

SECTION 263353 - STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SUMMARY:

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. This Section includes the furnishing and installing of a three-phase, on-line, static-type, UPS installations, complete with transient voltage surge suppression, input harmonics reduction, rectifier-charger, battery, battery disconnect device, inverter, static bypass transfer switch and all accessories. UPS systems shall be installed for the platform and utility building lighting and communication racks.

1.2 DEFINITIONS:

- A. EMI: Electromagnetic interference.
- B. LCD: Liquid-crystal display.
- C. LED: Light-emitting diode.
- D. THD: Total harmonic distortion.
- E. UPS: Uninterruptible power supply.

1.3 SUBMITTALS:

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: Include data on features, components, ratings, and performance for each uninterruptible power supply component indicated.
- C. Shop Drawings: Detail assemblies of equipment indicating dimensions, weights, components, and location and identification of each field connection. Show access,

workspace, and clearance requirements; details of control panels; and battery arrangement.

1. Wiring Diagrams: Detail internal and interconnecting wiring; and power, signal, and control wiring. Differentiate between field-installed and factory-installed wiring and components.
 - D. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.
 - E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
 - F. Factory Test Reports: Comply with specified requirements.
 - G. Field Test Reports: Indicate test results compared with specified performance requirements, and provide justification and resolution of differences if values do not agree.
 - H. Maintenance Data: For UPS units to include in maintenance manuals. Include the following:
 1. Lists of spare parts and replacement components recommended being stored at Project site for ready access.
 2. Detailed operating instructions covering operation under both normal and abnormal conditions.
 - I. Warranties: Special warranties specified in this Section.
- 1.4 CLOSOUT SUBMITTALS:
- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.
- 1.5 QUALITY ASSURANCE:
- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01
 - B. Installer Qualifications: An experienced installer who is an authorized representative of UPS manufacturer for both installation and maintenance of units required for this Project.
 - C. Power Quality Consultant Qualifications: A registered professional electrical engineer or engineering technician, currently certified by the National Institute for Certification in Engineering Technologies, NICET level 4, minimum, experienced in functional

performance testing UPS installations and in performing power quality surveys similar to that required in Part 3 "Functional Performance Testing" Article.

- D. **Manufacturer Qualifications:** A firm who maintains a service center capable of providing training, parts, and emergency maintenance and repairs for equipment at Project site with eight hours' maximum response time.
- E. **Testing Agency Qualifications:** An independent testing agency with experience and capability to conduct testing indicated without delaying the Work, as documented according to OSHA criteria for accreditation of testing laboratories, 29 CFR 1910.7; or a full member company of the International Electrical Testing Association.
 - 1. **Testing Agency's Field Supervisor:** Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- F. **Source Limitations:** Obtain the UPS and associated components specified in this Section from a single manufacturer with responsibility for entire UPS installation.
- G. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70-2011, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 1. **UPS Units:** Listed and labeled under UL 1778.
 - 2. **Mark UPS components as suitable for installation in computer rooms according to NFPA 75.**

1.6 DELIVERY, STORAGE, AND HANDLING:

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information
- B. Deliver equipment in fully enclosed vehicles after specified environmental conditions have been permanently established in spaces where equipment is to be placed.
- C. Store equipment in spaces with environments controlled within manufacturers' ambient temperature and humidity tolerances for non-operating equipment.

1.7 WARRANTY:

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information
- B. **Warranties, General:** Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract

Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

C. Special Battery Warranties: Written warranty, signed by manufacturer and Installer agreeing to replace UPS system storage batteries that fail in materials or workmanship within specified warranty period.

1. Warranted Cycle Life for Premium Sealed Lead-Acid Batteries: Equal or greater than that represented in manufacturer's published table, including figures corresponding to the following, based on annual average battery temperature of 77 deg F (25 deg C):

Discharge Rate	Discharge Duration	Discharge End Voltage	Cycle Life
8 hours	8 hours	1.67	40 cycles
30 minutes	30 minutes	1.67	125 cycles
15 minutes	1 minute	1.67	750 cycles

D. Special UPS Warranties: Written warranties, signed by manufacturer and Installer agreeing to replace components that fail in materials or workmanship within special warranty period.

1. Special Warranty Period: Three years from date of Substantial Completion.

1.8 EXTRA MATERIALS:

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to the client.

1. Cabinet Ventilation Filters: One complete set.
2. One spare circuit board for each critical circuit.

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

- or
- 2. Approved equal.

2.2 DESCRIPTION:

- A. 15kVA UPS rated at 0.9 power factor;
- B. Nominal Input 208/120V
- C. Operating frequency: 50/60Hz
- D. Input Power Factor: 0.99 typical
- E. Nominal Output Voltage: 208/120V
- F. Efficiency: 90% typical

2.3 FUNCTIONAL DESCRIPTION:

- A. Automatic operation includes the following:
 - 1. Normal Conditions: Supply the load with ac power flowing from the normal ac power input terminals, through the rectifier-charger and inverter, with the battery connected in parallel with the rectifier-charger output.
 - 2. Abnormal Supply Conditions: If normal ac supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to maintain constant, regulated inverter ac power output to the load without switching or disturbance.
 - 3. If normal power fails, energy supplied by the battery through the inverter continues supply-regulated ac power to the load without switching or disturbance.
 - 4. When power is restored at the normal supply terminals of the system, controls automatically synchronize the inverter with the external source before transferring the load. The rectifier-charger then supplies power to the load through the inverter and simultaneously recharges the battery.
 - 5. If battery becomes discharged and normal supply is available, the rectifier-charger charges the battery. On reaching full charge, the rectifier-charger automatically shifts to a float-charge mode.
 - 6. If any element of the UPS system fails and power is available at the normal supply terminals of the system, the static bypass transfer switch switches the load to the normal ac supply circuit without disturbance or interruption of supply.
 - 7. If a fault occurs in the system supplied by the UPS and current flows in excess of the overload rating of the UPS system, the static bypass transfer switch operates to bypass the fault current to the normal ac supply circuit for fault clearing.
 - 8. When the fault has cleared, the static bypass transfer switch returns the load to the UPS system.

9. If battery is disconnected, the UPS continues to supply power to the load with no degradation of its regulation of voltage and frequency of the output bus.

B. Manual operation includes the following:

1. Turning the inverter off causes the load to be transferred by the static bypass transfer switch directly to the normal ac supply circuit without disturbance or interruption.
2. Turning the inverter on causes the static bypass transfer switch to transfer the load to the inverter.

C. Maintenance Bypass/Isolation Switch Operation: Switch is interlocked so it cannot be operated unless static bypass transfer switch is in the bypass mode. Device provides manual selection between the following three conditions without interrupting supply to the load during switching:

1. Full Isolation: Load is supplied, bypassing the UPS. Normal UPS ac input circuit, static bypass transfer switch, and UPS load terminals are completely disconnected from external circuits.
2. Maintenance Bypass: Load is supplied, bypassing the UPS. UPS ac supply terminals are energized to permit operational checking, but system load terminals are isolated from the load.
3. Normal: Normal UPS ac supply terminals are energized and the load is supplied through either the static bypass transfer switch and UPS rectifier-charger and inverter, or the battery and the inverter.

2.4 SERVICE CONDITIONS:

A. Environmental Conditions: UPS shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage or degradation of operating capability, except battery performance.

1. Ambient Temperature for Electronic Components: 32 to 104 deg F (0 to 40 deg C).
2. Ambient Temperature for Battery: 41 to 95 deg F (5 to 35 deg C).
3. Relative Humidity: 0 to 95 percent, noncondensing.
4. Altitude: Sea level to 4000 feet (1220 m).

2.5 PERFORMANCE REQUIREMENTS:

A. UPS shall perform as specified in this Article while supplying rated full-load current, composed of any combination of linear and nonlinear load, up to 100 percent nonlinear load with a load crest factor of 3.0, under the following conditions or combinations of the following conditions:

1. Inverter is switched to battery source.

2. Steady-state ac input voltage deviates up to plus or minus 10 percent from nominal voltage.
 3. Steady-state input frequency deviates up to plus or minus 5 percent from nominal frequency.
 4. THD of input voltage is 15 percent or more with a minimum crest factor of 3.0, and the largest single harmonic component is a minimum of 5 percent of the fundamental value.
 5. Load is 30 percent unbalanced continuously.
- B. Minimum Duration of Supply: If battery is sole energy source supplying UPS-rated full-output load current at 80 percent power factor, duration of supply is 4 hours, with ambient temperature between 68 to 86 deg F (20-30 deg C).
- C. Input Voltage Tolerance: System steady-state and transient output performance remains within specified tolerances when steady-state ac input voltage varies plus 10, minus 20 percent from nominal voltage.
- D. Overall UPS Efficiency: Equal to or greater than 80 percent at 100 percent load, 80 percent at 75 percent load, and 80 percent at 50 percent load.
- E. Maximum Energizing Inrush Current: Eight times the full-load current.
- F. Maximum AC Output-Voltage Regulation for Loads up to 50 Percent Unbalanced: Plus or minus 2 percent over the full range of battery voltage.
- G. Output Frequency: 60 Hz, plus or minus 0.5 percent over the full range of input voltage, load, and battery voltage.
- H. Limitation of harmonic distortion of input current to the UPS shall be as follows:
1. Description: Either a tuned harmonic filter or an arrangement of rectifier-charger circuits shall limit THD to 5 percent, maximum, at full-rated UPS load current, for power sources with X/R ratio between 2 and 30.
 2. Description: THD is limited to a maximum of 32 percent, at full-rated UPS load current, for power sources with X/R ratio between 2 and 30.
- I. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent RMS total and 3 percent RMS for any single harmonic, for 100 percent rated nonlinear load current with a load crest factor of 3.0.
- J. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent RMS total and 3 percent RMS for any single harmonic for rated full load with THD up to 50 percent, with a load crest factor of 3.0.
- K. Minimum Overload Capacity of UPS at Rated Voltage: 125 percent of full-load rating for 10 minutes, and 150 percent for 10 seconds in all operating modes.

- L. Maximum Output-Voltage Transient Excursions from Rated Value: For the following instantaneous load changes, stated as percentages of rated full UPS load, voltage shall remain within stated percentages of rated value and recover to, and remain within, plus or minus 2 percent of that value within 100 ms:
 - 1. 50 Percent: Plus or minus 8 percent.
 - 2. 100 Percent: Plus or minus 10 percent.
 - 3. Loss of AC Input Power: Plus or minus 5 percent.
 - 4. Restoration of AC Input Power: Plus or minus 5 percent.
- M. Input Power Factor: A minimum of 0.85 lagging when supply voltage and current are at nominal rated values and UPS is supplying rated full-load current.
- N. EMI Emissions: Comply with FCC Rules and Regulations, 47 CFR 15 for Class A equipment.

2.6 SYSTEM COMPONENTS, GENERAL:

- A. Electronic Equipment: Solid-state devices using hermetically sealed, semiconductor elements. Devices include rectifier-charger, inverter, static bypass transfer switch, and system controls.
- B. Enclosures: Comply with NEMA 250, Type 1, unless otherwise indicated.
- C. Control Assemblies: Mount on modular plug-ins, readily accessible for maintenance.
- D. Surge Suppression: Protect internal UPS components from surges that enter at each ac power input connection including main disconnect, static bypass transfer switch. Protect rectifier-charger, inverter, controls, and output components.
 - 1. Use factory-installed surge suppressors tested according to IEEE C62.41, Category B.
 - 2. Additional Surge Protection: Protect internal UPS components from low-frequency, high-energy voltage surges described in IEEE C62.41. Design the circuits connecting with external power sources and select circuit elements, conductors, conventional surge suppressors, and rectifier components and controls so input assemblies will have adequate mechanical strength and thermal and current-carrying capacity to withstand stresses imposed by 40-Hz, 180 percent voltage surges described in IEEE C62.41.
- E. Maintainability Features: Mount rectifier-charger and inverter sections and static bypass transfer switch on modular plug-ins, readily accessible for maintenance.
- F. Capacity Upgrade Capability: Arrange wiring, controls, and modular component plug-in provisions to permit future 25 percent increase in UPS capacity.

- G. Seismic-Restraint Design: UPS assemblies, subassemblies, and components; and fastenings and supports, mounting, and anchorage devices for them, shall be designed and fabricated to withstand static and seismic forces in any direction.
- H. UPS Cabinet Ventilation: Redundant fans or blowers draw in ambient air near the bottom of the cabinet and discharge it near the top rear.
- I. Output Circuit Neutral Bus, Conductor, and Terminal Ampacity: Rated phase current times a multiple of 1.73, minimum.

2.7 RECTIFIER-CHARGER:

- A. Capacity: Adequate to supply the inverter during full-rated output load conditions and simultaneously recharge the battery from fully discharged condition to 95 percent of full charge within 10 times the rated discharge time for duration of supply under battery power at full load.
- B. Output Ripple: Limited by output filtration to less than 0.5 percent of rated current, peak to peak.
- C. Rectifier-Charger Control Circuits: Immune to frequency variations within rated frequency ranges of normal and emergency power sources.
 - 1. Response Time: Field adjustable for maximum compatibility with local generator-set power source.
- D. Battery Float-Charging Conditions: Comply with battery manufacturer's written instructions for battery terminal voltage and charging current required for maximum battery life.

2.8 INVERTER:

- A. Description: Pulse-width modulated, with sinusoidal output.

2.9 STATIC BYPASS TRANSFER SWITCH:

- A. Description: Solid-state switching device providing uninterrupted transfer. A contactor or electrically operated circuit breaker automatically provides electrical isolation for the switch.
- B. Switch Rating: Continuous duty at the rated full-load current of the UPS, minimum.

2.10 BATTERY:

A. Description: Sealed, premium, heavy-duty, valve-regulated, recombinant, lead-calcium units, factory assembled in an isolated compartment or in a separate matching cabinet, complete with battery disconnect switch.

1. Arrange for drawout removal of battery assembly from cabinet for test and inspection.

2.11 UPS CONTROL AND INDICATION:

A. Description: Group displays, indications, and basic system controls on a common control panel on front of UPS enclosure.

B. Minimum displays, indicating devices, and controls include those in lists below. Provide sensors, transducers, terminals, relays, and wiring required to support listed items. Alarms include an audible signal and a visual display.

C. Indications: Plain-language messages on a digital LCD or LED.

1. Quantitative indications shall include the following:

- a. Input voltage, each phase, line to line.
- b. Input current, each phase, line to line.
- c. Bypass input voltage, each phase, line to line.
- d. Bypass input frequency.
- e. System output voltage, each phase, line to line.
- f. System output current, each phase.
- g. System output frequency.
- h. DC bus voltage.
- i. Battery current and direction (charge/discharge).
- j. Elapsed time-discharging battery.

2. Basic status condition indications shall include the following:

- a. Normal operation.
- b. Load-on bypass.
- c. Load-on battery.
- d. Inverter off.
- e. Alarm condition exists.

3. Alarm indications shall include the following:

- a. Bypass ac input overvoltage or undervoltage.
- b. Bypass ac input overfrequency or underfrequency.
- c. Bypass ac input and inverter out of synchronization.
- d. Bypass ac input wrong-phase rotation.
- e. Bypass ac input single-phase condition.
- f. Bypass ac input filter fuse blown.
- g. Internal frequency standard in use.
- h. Battery system alarm.

- i. Control power failure.
- j. Fan failure.
- k. UPS overload.
- l. Battery-charging control faulty.
- m. Input overvoltage or undervoltage.
- n. Input transformer overtemperature.
- o. Input circuit breaker tripped.
- p. Input wrong-phase rotation.
- q. Input single-phase condition.
- r. Approaching end of battery operation.
- s. Battery undervoltage shutdown.
- t. Maximum battery voltage.
- u. Inverter fuse blown.
- v. Inverter transformer overtemperature.
- w. Inverter overtemperature.
- x. Static bypass transfer switch overtemperature.
- y. Inverter power supply fault.
- z. Inverter transistors out of saturation.
- aa. Identification of faulty inverter section/leg.
- bb. Inverter output overvoltage or undervoltage.
- cc. UPS overload shutdown.
- dd. Inverter current sensor fault.
- ee. Inverter output contactor open.
- ff. Inverter current limit.

- 4. Controls shall include the following:
 - a. Inverter on-off.
 - b. UPS start.
 - c. Battery test.
 - d. Alarm silence/reset.
 - e. Output-voltage adjustment.

D. Dry-form "C" contacts shall be available for remote indication of the following conditions:

- 1. UPS on battery.
- 2. UPS on-line.
- 3. UPS load-on bypass.
- 4. UPS in alarm condition.
- 5. UPS off (maintenance bypass closed).

2.12 OUTPUT DISTRIBUTION SECTION:

- A. Panelboard: Comply with Section 262416.

2.13 BASIC BATTERY MONITORING:

- A. Battery Ground-Fault Detector: Initiates alarm when resistance to ground of positive or negative bus of battery is less than 5000 ohms.
- B. Battery compartment smoke/high-temperature detector initiates an alarm when smoke or a temperature greater than 75 deg C occurs within the compartment.
- C. Annunciation of Alarms: At UPS control panel.

2.14 BATTERY CYCLE WARRANTY MONITORING:

- A. Description: Electronic device, acceptable to battery manufacturer as a basis for warranty action, for monitoring of charge-discharge cycle history of batteries covered by a cycle-life warranty.
- B. Basic Functional Performance: Automatically measures and records each discharge event, classifies it according to duration category, and totals discharges according to warranty criteria, displaying remaining warranted battery life on integral LCD.
- C. Additional monitoring functions and features shall include the following:
 - 1. Measuring and Recording: Total voltage at battery terminals, providing alarm for excursions outside the proper float voltage level.
 - 2. Monitors: Ambient temperature at battery and initiates an alarm if temperature deviates from normally acceptable range.
 - 3. Keypad on Device Front Panel: Provides access to monitored data using front panel display.
 - 4. Alarm Contacts: Arranged to provide local alarm for abnormal battery voltage or temperature.
 - 5. Memory: Device stores recorded data in nonvolatile electronic memory.
 - 6. RS-232 Port: Permits downloading data to a portable personal computer.
 - 7. Modem: Makes measurements and recorded data accessible to remote personal computer via telephone line. Computer is not specified in this Section.

2.15 SOURCE QUALITY CONTROL:

- A. Factory test complete UPS, including battery, before shipment. Include the following tests:
 - 1. Functional test and demonstration of all functions, controls, indicators, sensors, and protective devices.
 - 2. Full-load test.
 - 3. Transient-load response test.
 - 4. Overload test.
 - 5. Power failure test.

6. Efficiency test at 50, 75, and 100 percent of rated full-load current at rated power factor.
- B. Observation of Test: Give 14 days advance notice of tests and provide opportunity for the client's representative to observe tests at their option.
 - C. Report test results. Include the following data:
 1. Description of input source and output loads used. Describe actions required to simulate source load variation and various operating conditions and malfunctions.
 2. List of indications, parameter values, and system responses considered satisfactory for each test action. Include tabulation of actual observations during test.
 3. List of instruments and equipment used in factory tests.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install system components on 4-inch- (100-mm-) high concrete bases. Cast-in-place concrete, reinforcing, and formwork are specified in Division 3.
- B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70-2005.
- C. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams, unless otherwise indicated.

3.2 GROUNDING:

- A. Comply with Section 260526 - Grounding for materials and installation requirements.
- B. Separately Derived Systems: If not part of a listed power supply for a data-processing room, comply with NFPA 70-2005 requirements for connecting to grounding electrodes and for bonding to metallic piping near isolation transformer.

3.3 IDENTIFICATION:

- A. Identify components and wiring according to Section 26 - Labeling and Identification.
 1. Identify each battery cell individually.

3.4 BATTERY EQUALIZATION:

- A. Equalize charging of battery cells according to manufacturer's written instructions. Record individual-cell voltages.

3.5 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Service: Engage the services of a factory-authorized service representative to supervise UPS installation, startup, and preliminary testing and adjustment and to participate in final tests, inspections, and adjustments.

- B. Electrical Tests and Inspections: Perform tests and inspections according to manufacturer's written instructions and as listed below to demonstrate condition and performance of each component of the UPS:

- 1. Inspect interiors of enclosures, including the following:

- a. Integrity of mechanical and electrical connections.
- b. Component type and labeling verification.
- c. Ratings of installed components.

- 2. Test manual and automatic operational features and system protective and alarm functions.

- 3. Test communication of status and alarms to remote monitoring equipment.

- C. Electrical Tests and Inspections: Perform tests and inspections listed below by an independent testing agency meeting the qualifications specified in "Quality Assurance" Article according to manufacturer's written instructions and as listed below to demonstrate condition and performance of each UPS:

- 1. Inspect interiors of enclosures, including the following:

- a. Integrity of mechanical and electrical connections.
- b. Component type and labeling verification.
- c. Ratings of installed components.

- 2. Load the system using a variable-load bank to simulate kilovolt amperes, kilowatts, and power factor of loads for the unit's rating. Use instruments calibrated, within the previous six months according to NIST standards.

- a. Simulate malfunctions to verify protective device operation.
- b. Test duration of supply on emergency, low-battery voltage shutdown, and transfers and restoration due to normal source failure.
- c. Test harmonic content of input and output current less than 25, 50, and 100 percent of rated loads.
- d. Test output voltage under specified transient-load conditions.
- e. Test efficiency at 50, 75, and 100 percent rated loads.
- f. Test remote status and alarm panel functions.
- g. Test battery-monitoring system functions.

- D. Seismic-restraint tests and inspections shall include the following: Inspect type, size, quantity, arrangement, and proper installation of mounting or anchorage devices.
- E. Retest: Correct deficiencies and retest until specified requirements are met.
- F. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.

3.6 DEMONSTRATION:

- A. Engage a factory-authorized service representative to train CTDOT (Amtrak) maintenance personnel to adjust, operate and maintain the UPS.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
 - 2. Review data in maintenance manuals.
 - 3. Schedule training with client's personnel, through Architect, with at least seven days advance notice.

3.7 FUNCTIONAL PERFORMANCE TESTING:

- A. Monitoring and Testing Schedule: Perform monitoring and testing a single 10-day period.
 - 1. Schedule monitoring and testing activity with client's personnel, through Architect, with at least 14 days' advance notice.
 - 2. Schedule monitoring and testing after Substantial Completion, when UPS is supplying power to its intended load.
- B. Monitoring and Testing Instruments: Three-phase, recording power monitors. Instruments shall provide continuous simultaneous monitoring of electrical parameters at input terminals of the UPS and at input terminals of a load served by the UPS. Instruments shall monitor, measure, and graph voltage current and frequency simultaneously and provide full-graphic recordings of the values of those parameters before and during power line disturbances that cause the values to deviate from normal beyond the adjustable threshold values. Instruments shall be capable of recording either on paper or on magnetic media and have a minimum accuracy of plus or minus 2 percent for electrical parameters. Parameters to be monitored include the following:
 - 1. Current: Each phase and neutral and grounding conductors.
 - 2. Voltage: Phase to phase, phase to neutral, phase to ground, and neutral to ground.
 - 3. Frequency transients.
 - 4. Voltage swells and sags.
 - 5. Voltage impulses, phase to phase, phase to neutral, phase to ground, and neutral to ground.

6. High-frequency noise.
7. Radio-frequency interference.
8. THD of the above currents and voltages.
9. Harmonic content of currents and voltages above.

C. Monitoring and Testing Procedure: As follows for each test period:

1. Exploratory Period: For approximately the first two days of the first scheduled monitoring and testing period, make recordings at various circuit locations and with various parameter-threshold and sampling-interval settings. Make these preliminary measurements with the objective of identifying optimum UPS, power system, load, and instrumentation set-up conditions for subsequent test and monitoring operations.
2. Remainder of Test Period: Perform continuous monitoring of at least two circuit locations selected on the basis of data obtained during exploratory period.
 - a. Set thresholds and sampling intervals for recording data at values selected to optimize data on performance of the UPS with respect to values specified in Part 2 of this Section, and to highlight any need to adjust, repair, or modify the UPS or any distribution system or load component that may influence its performance or that may require better power quality.
 - b. Perform load and UPS power source switching and operate the UPS on generator power during portions of the test period according to directions of client's Power Quality Consultant.
 - c. Operate the UPS and UPS loads in each mode of operation permitted by UPS controls and by the power distribution system design.
 - d. Create and simulate unusual operating conditions, including outages, voltage swells and sags, and voltage, current, and frequency transients that can be performed using loads and devices available as part of the facility's installed systems and equipment. Maintain normal operating loads in operation on system to maximum extent possible during tests.
 - e. Make adjustments and repairs to UPS, distribution, and load equipment to correct deficiencies disclosed by monitoring and testing and repeat appropriate monitoring and testing to verify success of corrective action.

D. Correlation with Specified UPS Monitoring Functions: Obtain printout recordings of built-in monitoring functions specified for UPS and UPS components in this Section that are simultaneous with those made with portable instruments in this Article.

1. Provide the temporary use of an appropriate personal computer and printer equipped with required connections and software for recording and printing if such units are not available on-site.
2. Correlate printouts with recordings for monitoring performed according to this Article, and resolve and report any anomalies in and discrepancies between the two sets of records.

E. Monitoring and Testing Assistance by Contractor: As follows:

1. Open UPS and electrical distribution and load equipment and wiring enclosures to make monitoring and testing points accessible for temporary monitoring probe and sensor placement and removal as requested.
 2. Observe monitoring and testing operations and ensure UPS and distribution and load equipment warranties are not compromised.
 3. Perform switching and control of various UPS units, electrical distribution systems, and load components as directed by Power Quality Consultant. The consultant shall design this portion of monitoring and testing operations to expose the UPS to various operating environments, conditions, and events while response is observed, electrical parameters are monitored, and system and equipment deficiencies are identified.
 4. Make repairs and adjustments to the UPS and to electrical distribution system and load components, and retest and repeat monitoring as needed to verify validity of results and correction of deficiencies.
 5. Engage the services of UPS manufacturer's factory-authorized service representative periodically through functional performance testing operations for repairs, adjustments, and consultations.
- F. Documentation: Record test point and sensor locations, instrument settings, and circuit and load conditions for each monitoring summary and power disturbance recording. Correlate simultaneous recordings made on UPS input and load circuits.
- G. Analysis of Recorded Data and Report: Review and analyze test observations and recorded data and submit a detailed written report. Include the following in report:
1. Description of corrective actions performed during monitoring and survey work and their results.
 2. Recommendations for further action to provide optimum performance by the UPS and appropriate power quality for non-UPS loads. Include a statement of priority ranking and a cost estimate for each recommendation that involves system or equipment revisions.
 3. Copies of monitoring summary graphics and graphics illustrating harmonic content of significant voltages and currents.
 4. Copies of graphics of power disturbance recordings that illustrate findings, conclusions, and recommendations.
 5. Recommendations for operating, adjusting, or revising UPS controls.
 6. Recommendation for alterations to the UPS installation.
 7. Recommendations for adjusting or revising generator-set or automatic transfer switch installations or their controls.
 8. Recommendations for power distribution system revisions.
 9. Recommendations for adjusting or revising electrical loads, or their connections or controls.
- H. Interim and Final Reports: Provide an interim report at the end of each test period and a final comprehensive report at the end of the final test and analysis period.

END OF SECTION 263353

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes transfer switches rated 600 V and less, including the following:
Non-automatic transfer switches.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. 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, bypass/isolation switch, power sources, generator plug and load. Show interlocking provisions for each combined transfer switch and bypass/isolation switch.

1.3 INFORMATIONAL SUBMITTALS

- A. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- B. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 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. Source Limitations: Obtain non-automatic transfer switches, through one source from a 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 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.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
 - 1. Notify Engineer and Owner no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Engineers and Owner's written permission.
 - 3. In case of emergency, when the existing utility service fails and a generator is brought to the site, only the owner will decide on the transfer to the generator.
 - 4. Provide proper Unistrut supports and concrete pad for the transfer switch unit and generator plug outside of the utility room

1.6 COORDINATION

- A. Coordinate size and location of transfer switch and generator plug per drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Transfer Switches Using Molded-Case Switches or Circuit Breakers Retain "Manufacturers" Subparagraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer.
 - b. Hubbell Industrial Controls, Inc.
 - c. Lake Shore Electric Corporation.
 - d. or Approved Equal.

2.2 GENERATOR PLUG, IF USED

- A. Use only units approved by the Engineer with short circuit overload protection
 - 1. Manufacturers Subject to compliance with requirements, provide products by one of the following:
 - a. Powertron.
 - b. Meltric
 - c. Union Connector

2.3 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.

3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Switching. Provide a 3 pole transfer switch listed and labeled "suitable for the use as service equipment:". Use a "break-before-make" sequence to provide transfer of all ungrounded conductors to the standby load.
- H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- I. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
- J. Enclosures: General-purpose NEMA 250, Type 3R or 4X for outdoor use complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.4 NONAUTOMATIC TRANSFER SWITCHES

- A. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- B. Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternate Source." In addition, removable manual handle provides quick-make, quick-break manual-switching action. Switch shall be capable of electrically or manually transferring load in either direction with either or both sources energized. Control circuit disconnects from electrical operator during manual operation.
- C. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.
- D. Nonautomatic Transfer-Switch Accessories:
 1. Pilot Lights: Indicate source to which load is connected.
 2. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternate-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Alternate Source Available."
 3. Unassigned Auxiliary Contacts: One set of normally closed contacts for each switch position, rated 10 A at 240-V ac.

2.5 REMOTE ANNUNCIATOR SYSTEM

- A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:
 - 1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 - 2. Switch position.
 - 3. Switch in test mode.
 - 4. Failure of communication link.
- B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
 - 1. Indicating Lights: Grouped for each transfer switch monitored.
 - 2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
 - 3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
 - 4. Lamp Test: Push-to-test or lamp-test switch on front panel.
 - 5. Control of switch operation in either direction.
- C. Remote Annunciation 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.

2.6 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. Floor-Mounting Switch: Anchor to floor by bolting.
 - 1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the

maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Section 260529 "Hangers and Supports for Electrical Systems."

- B. Supported Switch: Support on Unistrut on concrete base.
- C. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- D. Identify components according to Section 260553 "Identification for Electrical Systems."
- E. 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. Connection to generator plug as required by manufacturer.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 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.
 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.
- C. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

- A. 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.
- B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 264313 – SURGE PROTECTIVE DEVICES FOR LOW VOLTAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY:

- A. Section Includes:
 - 1. Distribution panelboards for station, platforms.
 - 2. Lighting and appliance branch-circuit panelboards.
- B. The Contractor shall furnish and install the Transient Voltage Surge Suppression (TVSS) equipment having the electrical characteristics, ratings and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability, the AC surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway and/or motor control centers. Refer to related sections for surge requirements in:
 - 1. Section 262416 – Panelboards

1.3 DEFINITIONS:

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor or
- C. SPD: Surge Protector Device

1.4 PERFORMANCE REQUIREMENTS:

- A. Seismic Performance: TVSS equipment 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."

1.5 REFERENCES

- A. Electrical Codes: All electrical work covered by the Contract Documents shall conform to the requirements of National Electrical Code, 2017 Edition, state and other local codes.
- B. Listings: All equipment and materials for which Underwriters' Laboratories, Inc. provides product listing service shall be Underwriters' Laboratories' approved and bear the U.L. Label
- C. Standards: TVSS units and all components shall be designed, manufactured and tested in accordance with the latest applicable following standards:
 - 1. National Electrical Manufacturers Association (NEMA).
 - 2. Institute of Electrical and Electronic Engineers (IEEE).
 - 3. American National Standards Institute (ANSI) ANSI/IEEE C62.41& C62.45.
 - 4. Underwriters Laboratory (UL) Listed standards (UL 1449, & UL 1283)

1.6 SUBMITTALS:

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of transient voltage suppression device, accessory, and component provide verification that the TVSS device complies with this specification and UL 1449. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- C. Shop Drawings: For each panelboard and related TVSS equipment:
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.

3. Detail bus configuration, current, and voltage ratings.
 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 5. Include evidence of NRTL listing for series rating of installed devices.
 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 7. Include wiring diagrams for power, signal, and control wiring.
 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
 9. Provide actual let through voltage test data
 10. Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying the devices noise attenuation equal or exceeds 50 dB at 100 kHz
 11. Provide test report in compliance with NEMA LS1 from a recognized independent testing laboratory verifying the suppressor components can survive published surge current rating on both a per mode and per phase basis using the IEEE C62.41, 8 x 20 microsecond current wave. Note that test data on individual module is not accepted.
- D. Seismic Qualification Certificates: Submit certification that TVSS and the panelboards, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
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.
- E. Field Quality-Control Reports:
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.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals.

1. Manufacturer's written instructions for testing and adjusting TVSS devices.

1.7 CLOSEOUT SUBMITTALS:

A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.8 QUALITY ASSURANCE:

A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

B. 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.

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.

1.9 PROJECT CONDITIONS:

A. Environmental Limitations:

1. Do not deliver or install TVSS equipment until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F

b. Altitude: Not exceeding 6600 feet

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet

1.10 COORDINATION:

- A. Coordinate layout and installation of TVSS equipment and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

1.11 DELIVERY, STORAGE AND HANDLING:

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.12 WARRANTY:

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS:

- A. Electrical Requirements:
 1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall be greater than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge suppressor for the service entrance and other distribution level. The system shall not utilize components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – For a Wye configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a Delta-configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).
5. The maximum Suppressed Voltage Rating (SVR) per UL 1449 2nd Edition must not exceed the following:

Modes	208Y/120 & 120/240	240 Delta	480Y/277	480 Delta	600Y/347	600 Delta
L-N and/or L-G	400V	800V	800V	1500 V	1000V	2000V
N-G	400V	-	800V	-	1000V	-
L-L	800V	800V	1500V	1500 V	2000V	2000V

6. ANSI/IEEE Cat. C3 Let Through Voltage – The let through voltage based on IEEE C62.41 and C62.45 recommended procedures for Category C3 surges (20 kV, 10 kA) shall be less than:

Modes	208Y/120 & 120/240	480Y/277	600Y/347
L-N	550V	900V	1200V

B. TVSS Design:

1. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating TVSS modules shall not be acceptable.
2. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHz using the MIL-STD-220A insertion loss test method. Products not able to demonstrate noise attenuation of 50 dB @ 100 kHz shall be rejected.

3. Extended Range Filter – The Surge Protective Device shall have a High Frequency Extended Range Tracking Filter in each Line to Neutral mode with compliance to UL 1283 and NEMA LS1. The filter shall have published high frequency attenuation rating in the attenuation frequencies.

Attenuation Frequency	50kHz	100kHz	500kHz	1MHz	10MHz	100MHz
Insertion Loss (ratio)	40	316	316	89	200	79
Insertion Loss (dB)	32	50	50	39	46	38

4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.
5. Standard Monitoring Diagnostics – Each TVSS shall provide integral monitoring options:
 - a) Each unit shall provide a green / red solid state indicator light shall be provided on each phase. The absence of a green light and the presence of a red light, shall indicate which phase(s) have been damaged.
 - b) Audible Alarm – The TVSS shall provide an audible alarm with a reset pushbutton that will be activated under any fault condition.
 - c) Event Counter – The TVSS shall be equipped with an LCD display system designed to indicate to the user how many surges, sags, swells and outages have occurred at the location. The event counter triggers each time under each respective category after significant event occurs. A reset pushbutton shall also be standard allowing all counters to be zeroed.
 - d) Push to Test – The TVSS shall be equipped with push-to-test feature, designed to provide users with real time testing of the suppressor’s monitoring and diagnostic system. By depressing the test button, the diagnostic system initiates a self test procedure. If the system is fully operational, the self test will activate all indicator lights.
 - e) Voltage Monitoring – The TVSS shall display true Root Mean Square (RMS) on three L-N voltage protection mode on Wye configuration and three L-L voltage on Delta configuration.
6. Overcurrent Protection shall allow protection during high surge (kA) events with individually fused MOV’s
7. The TVSS shall be immediately installed on the load side of the main breaker

8. A direct bus bar connection shall be used to mount the TVSS component to the panelboard bus bar to reduce the impedance of the shunt path
 9. The TVSS shall be included and mounted within the panelboard by the manufacturer of the panelboard.
 10. All monitoring diagnostics features shall be visible from the front of the equipment
- C. Fabricate and test TVSS equipment according to requirements listed above.
- D. Enclosures: Surface-mounted cabinets.
1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 2. All enclosed equipment shall be the same type enclosures as the panelboards, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Compression type.
 3. Ground Lugs and Bus-Configured Terminators: Compression type.
- F. TVSS Short-Circuit Current Rating: Fully rated to withstand symmetrical short-circuit current available at terminals.

2.2 TVSS MANUFACTURES:

- A. Manufacturers: Eaton Electrical Inc.; Cutler-Hammer Business Unit or approved equal.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES:

- A. Manufacturers: Eaton Electrical Inc.; Cutler-Hammer Business Unit or approved equal.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING:

- A. Remove loose packing and flammable materials from inside TVSS, prevent condensation if stored outdoors.

- B. Handle, store and prepare TVSS for installation in accordance with manufacturer's instructions, and NEMA PB 1.
- C. Examine TVSS before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

3.2 INSTALLATION:

- A. Install TVSS and accessories as per the manufacturer's recommendations and the contract drawings, in all panels.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- D. Mount plumb and rigid without distortion of box.
- E. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.3 IDENTIFICATION:

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 TESTING:

- A. Perform tests and inspections.

1. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NETA, NEMA and UL standards.
2. Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. TVSS will be considered defective if they do not pass tests and inspections.
4. 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.

END OF SECTION 264313

SECTION 265200 EMERGENCY LIGHTING

PART 1 GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. Section includes emergency lighting and exit signs.
- D. Related Sections:
 - 1. Section 260526 - Grounding and Bonding for Electrical Systems.
 - 2. Section 260533 - Raceway and Boxes for Electrical Systems.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- B. Underwriters Laboratories, Inc. (UL):
 - 1. UL 924 Listed (Emergency Lighting).

1.3 SYSTEM DESCRIPTION

- A. Emergency lighting to comply with requirements of NFPA 101 and IESNA Illumination Guide – Transportation and Facilities Sections.
- B. Platforms and Utility Building: All fixtures will be on Emergency, supplied from the UPS. The illumination level on the egress path will not be under 1fc.
- C. Exit signs shall be located as per NFPA 101 or as shown on plans and shall be continuous illuminated to mark the means of egress.

1.4 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: Submit dimensions, ratings and performance data.

1.5 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

1.7 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.9 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

PART 2 PRODUCTS

2.1 EXIT SIGNS

- A. Manufacturers:
 - 1. Lithonia,
 - 2. Dual Light
 - or
 - 3. Approved equal.
- B. Product Description: Exit sign fixture, injection-model, flame retardant, high impact construction with LED lamp, directional arrows and universal mounting kit

- C. Input Voltage: 120V.
- D. Directional Arrows: Unless otherwise indicated on the on Drawings, arrows will indicate the exit direction.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install suspended exit signs using pendants supported from swivel hangers. Install pendant length required to suspend sign at indicated height.
- B. Install surface-mounted emergency lighting units and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- C. Install wall-mounted emergency lighting units and exit signs at height as indicated in manufacturer literature
- D. Install accessories furnished with each exit sign.
- E. Connect emergency lighting units and exit signs to branch circuit supplied by UPS
- F. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within unit.
- G. Ground and bond emergency lighting units and exit signs in accordance with Section 26 05 26.

3.2 FIELD QUALITY CONTROL

- A. Field inspecting, testing, adjusting, and balancing.
- B. Test and operate each unit after installation and connection in the presence of engineer and OSFM. Inspect for proper connection and operation.

END OF SECTION 265200

SECTION 265600 –LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak and Metro-North regarding track outages, flagmen or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.
- C. The Contractor shall provide all lighting fixtures, labor, material, etc., in accordance with the preceding specifications, the requirements of this Section and as shown on the Contract Drawings.
- D. Both outdoor platform lighting and utility building indoor fixtures are included under this Section.
- E. All lighting fixtures shall have the Underwriters' Laboratories label which indicates compliance with appropriate standards or performance in a specified manner.
- F. All wiring shall be placed in conduit and shall comply with the specifications for conduits, outlet boxes, pull and junction boxes, wires and cables, grounding, etc., as set forth in these specifications and as noted herein.
- G. The Contractor shall submit for approval catalog cuts showing performance and construction details of standard fixtures and complete working drawings showing all proposed construction details for special or modified standard fixtures and shall submit photometric calculations. Exception is the outdoor pole and pole fixture that are the type approved by the Town of Windsor. **This is a sole source item and no substitutions will be allowed.**
- H. Manufacturer's catalog number and description in the fixture schedule establishes quality, style, finish, etc. The Contractor shall provide pigtails and flexible conduit where required and connections to the outlet box. The use of catalog number describing the various types of fixtures shall be used as a guide only and does not exclude all the required accessories or hardware that may be required for a complete installation.

Manufacturer for the platform and outdoor area site is Signify (Philips) HADCO as indicated on the drawings.

- I. Contractor shall accept responsibility for the coordination and proper relation of his work to the work of all trades. Contractor will visit the premises and thoroughly familiarize himself with all details of the work and working conditions, verify all dimensions in the field and advise the Engineer of any discrepancy before performing any work.
- J. Replace or repair defective equipment damaged in the course of installation or test.
- K. Protect metallic materials against corrosion. All equipment intended for outdoor use shall be given corrosion-inhibiting treatment and standard finish by the manufacturer. Aluminum shall not be used in contact with the earth, and where connected to dissimilar metal shall be protected by approved fittings and treatment.
- L. Compliance of the above specification shall be done according to the following:
 - 1. Ray-trace diagrams by computer graphics for each and every individual prism design for the lens shall be provided.
 - 2. Photometric test for compliance must be performed by an independent testing laboratory.
 - 3. Compliance of specifications must be certified by a registered Professional Electrical Engineer with at least 10 years experience in design of lens optics for luminaries.
 - 4. Successful supplier must have at least 10 years experience in manufacturing of ornamental luminaries and demonstrate successful installations in at least two major mass transit projects.
 - 5. The Contractor shall not proceed with the manufacturer or installation of any lighting fixtures before approval is obtained.
 - 6. The following engineering data for the fixtures to be installed under this Contract shall be submitted: distribution data and brightness characteristics of luminaire, photometric candle power charts for the mounting heights required and as specified herein. If other fixtures than the ones specified in Contract drawings are used, recalculation of lighting levels will be required.

1.2 MANUFACTURERS

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01. **This is a sole source item and no substitutions will be allowed.**
- B. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Contract Drawings.

1.3 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions. The following tests are required:
 - 1. Witnessed Shop Tests: None required.
 - 2. Field Acceptance Tests: Field tests shall be performed in accordance with requirements of Section 260800 Commissioning of Electrical Systems.

1.4 SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Submit the following:
 - 1. Shop drawings and data for lighting fixtures. Drawings shall show types, size, accessories, installation details, and other details of construction. Data accompanying shop drawings shall include aiming diagram and computerized footcandle array.
 - 2. Manufacturer's data for all fixtures indicating mechanical and electrical construction.
 - 3. Certified laboratory test reports for the following:

Computerized candlepower distribution data taken in perpendicular plane in angles of every five degrees between 0 and 90 degrees. Data shall have a mean deviation of 10 percent and a maximum deviation of 20 percent.
 - 5. Sample of each lighting fixture (one sample for each type).
- B. Each submittal shall be identified by the applicable Equipment Identification Number and Specification Section.

1.5 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01. **This is a sole source item and no substitutions will be allowed.**

1.7 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.8 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

1.9 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submissions will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Equipment specifications and data sheets identifying all materials used and methods of fabrication.
 - 2. Complete assembly, layout, and installation drawings with clearly marked dimensions.
 - 3. Example equipment nameplate data sheet.
 - 4. Interconnecting wiring diagrams.
 - 5. All fixture photometric data.

1.10 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions.

1.11 TOOLS, SUPPLIES AND SPARE PARTS

- A. The panels and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment
- B. Manufacturer does not recommend any spare parts.

1.12 IDENTIFICATION

- A. Each unit of equipment shall be identified with the equipment item numbers given on the Contract Drawings. A corrosion resistant tag or nameplate, securely affixed in a conspicuous place on each unit shall give the equipment item number, manufacturer's name or trademark and such other information as the manufacturer may consider necessary, or as specified, to complete identification.

1.13 REFERENCES

- A. Section 260529 – Hangers and Supports for ES.

1.14 CODES, LISTINGS AND STANDARDS

- A. Electrical Codes: All electrical work covered by the Contract Documents shall conform to the requirements of National Electrical Code, 2017 Edition, state and other local codes.

PART 2 - PRODUCTS

2.2 FIXTURES

- A. LED fixtures shall be high quality, homogeneous in texture, uniform in quality, free from defects, of uniform thickness throughout, and properly annealed. Edges shall be well rounded and free from chips or rough edges.
- B. These fixtures are intended as ones subject to abuse, and damp locations, and as such shall bear listing with the Underwriters' Laboratories as a damp-location fixture, enclosed and gasketed. Electrical feeds shall be through hubs at the end of the fixture.

1. Vandal-resistant construction shall consist of a 0.125-inch minimum uninterrupted thickness, color corrective, acrylic lens, retained by concealed stainless steel spring-loaded fasteners and interlocking extrusions. Entire mechanism shall be concealed within the extruded outer housing, such that the tamper resistant stainless hardware is flush with the outer wall of the luminaire.
- C. All fixtures shall be complete with poles, hangers, supports, lamps, shielding, diffusers, insulation and all other accessories required for mounting and proper operation. All fixtures shall be UL labels. Check architectural drawings to verify ceiling types. Verify color of exposed trim and shielding medium with Engineer before ordering fixtures.
 - D. All fixture assemblies to be factory pre-wired to prescribed circuitry.
 - E. Lamp wattage shall be as indicated, and all fixtures shall be suitable for outdoor and vandal-resistant installation.

2.3 LAMPS

- A. The Contractor shall furnish and install all fixtures as per lighting schedule and contract drawings.

2.4 LIGHTING POLES/FIXTURES

Lighting poles for platforms shall be fabricated in accordance with the lighting schedule and contract drawings as approved by the Town of Windsor. Poles shall accommodate the power requirements for all systems installed on the pole.

Fixtures: As specified in the lighting schedule and contract drawings and approved by the Town of Windsor.

2.6 ACCEPTABLE MANUFACTURERS

Manufacturers:

1. For platform poles and fixtures: Signify (Philips HADCO) as approved by the City of Windsor. **This is a sole source item and no change substitutions will be allowed.**
2. For all others: Lithonia Lighting, Signify, HE Williams or approved equal.

2.7 LIGHTING CONTROL

- A. Lighting control shall be as specified in 260923 - Lighting Control devices

2.8 EXIT SIGNS

- A. Exit lighting units, with high impact housing and internal high output LEDs will be fed from the emergency panel via UPS.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All lighting fixtures shall be installed in a neat and workmanlike manner and shall be mounted evenly and in line. Contractor shall determine the best location for fixtures and conduit runs. If, at any point, the construction will not permit the installation of the type of fixture shown on the Contract Drawings, the Contractor shall install a fixture of such type in such manner as directed by the Engineer. Where bracket fixtures are required, each fixture shall be adjusted to suit local conditions. Where pendant fixtures are required, approved suspension devices or rigid fittings shall be supplied and installed. Support pendant mounted fixtures with stems, 3/8" in diameter minimum, vertically attached to structural steel, concrete, beams, joists, and trusses. Contractor shall provide channel supports required to support the pendant fixtures. Wiring to pendant fixtures shall be run through the stem and iron bushing. All stem to box connections shall be secured with double nuts. All fixtures and hardware to be installed with Torx tamperproof screws. Stems for pendant fixtures shall be provided where necessary to make the height of all lamps uniform and in the same plane being dependent upon the minimum height of the ceiling in the areas indicated on the Contract Drawings. All steel and ceiling heights shall be verified in the field. All steel parts for the attachment of fixtures shall be hot-dip galvanized. Lead gaskets shall be provided between dissimilar metal mounting surfaces and metal to masonry interfaced.
- B. The Contractor shall install, wire and illuminate five (5) fixtures for use as a test pattern to be approved. Upon approval, the Contractor shall complete the remaining light fixtures installation.
- C. All fixtures shall be made clean and free of dust and all other foreign matter both on visible surfaces and on surfaces that affect the lighting performance of the fixture including diffusers, lenses, louvers, reflectors and lamps.
- D. Lighting fixtures location is subject to coordination with other trades and final location will be determine by the contractor and approved by the Engineer.

- E. The Contractor shall provide and install all inserts, conduit, structural supports as required, wiring, etc., and properly adjust and test, to the satisfaction of the Engineer, the entire lighting system.
- F. The Contractor shall protect all fixtures at all times from damage, dirt, dust, etc. Before final acceptance, all fixtures and devices shall be cleaned of all dust, dirt or other material, be fully relamped and in operating condition to the satisfaction of the Engineer.
- G. Circuiting shall be as shown on the Contract Drawings and as follows:
 - 1. Bus loads in all panelboards shall be balanced between phases to within a tolerance of one (1) kVA. Convenience receptacles shall be distributed evenly among all phase buses as much as practicable.
 - 2. Voltage drop to the most remote lighting fixture shall be limited to 3 percent.
- H. The Contractor shall supply all pendant trapezes and pendant stem hangers with durable swivel or equivalent trapeze hangers permitting normal fixture motion and self-alignment. Pendant lengths shall be adequate and adjusted to provide uniformity of installation heights above the reference datum. Stems shall be one piece, with matching canopies and fittings.
- I. The Contractor shall provide recessed fixtures with a separate junction box concealed and located as to be accessible when fixture is removed.
- J. All lighting units, when installed, shall be set true and be free of light leaks, warps, dents, and other irregularities. All hangers, cables, supports, channels, and brackets of all kinds for safely erecting this equipment in place, shall be furnished and erected in place by the Contractor.
- K. The Contractor shall install fixtures at mounting heights indicated or as instructed by the Engineer. In areas with exposed ducts and/or piping, installation of lighting fixtures shall be adapted to field conditions as determined by the Engineer.
- L. The Contractor shall support each fixture securely. The Contractor shall not secure fixtures to the work of other trades, unless specified or noted otherwise, and shall not support fixtures to plaster. The Contractor shall furnish and install all steel members and supports as required to fasten and suspend fixtures from the structure.

- M. In all mechanical equipment areas, the Contractor shall install lighting fixtures on ceiling after all piping and equipment therein have been installed. Exact locations for such fixtures may be determined by the Engineer on the site during the course of the work.
- N. Upon completion of work, and after the area is broom clean, all fixtures shall be made clean and free of dust and all other foreign matter both on visible surfaces, and on surfaces that affect the lighting performance of the fixture including diffusers, lenses, louvers, reflectors, and lamps.
- O. All fixtures that require physical adjustment shall be so adjusted in accordance with the directions of the Engineer. The Contractor shall also adjust angular direction of fixtures and/or lamps, as directed.
- P. Re-lamping access shall require no special tools. All optical control surfaces such as lenses and reflectors shall be safely and securely attached to fixtures and shall be easily and quickly removed and replaced for cleaning without the use of tools. No fixture part that may be removed, for maintenance, shall be held in place by metal tabs that must be bent to remove said part.
- Q. The Contractor shall install switches 4 ft. above the floor at the locations shown, and shall be single pole or double pole, as indicated.
- R. All switches shall be enclosed in cast boxes and shall be furnished with waterproof, cast covers having external operating arms equal to Russell and Stoll; Appleton Electric or equal, for surface mounting. The Contractor shall provide all covers with rubber or neoprene gaskets.
- S. Evenly proportion all fixtures in the room except where adjusted to conform with ceiling pattern as described below and where otherwise shown on drawings. Edges of the fixture shall be parallel with the walls.
- T. All fixtures must hang true to vertical, free from finger marks, flaws, scratches, dents or other imperfections. Take care when hanging fixtures not to deface in any way, ceiling or walls.
- U. Install continuous rows of fixtures in a straight line and at the same level. Fixtures must not be rotated about longitudinal axis with respect to one another. Mount surface fixtures tight to surface without distorting it. Provide proper mounting equipment for recessed fixtures to adapt them to the ceiling or wall construction and to prevent light leaks around trim. All stem mounted fixtures shall be hung level from self-aligning hangers in canopies.
- V. Securely support all ceiling fixtures, hangers, and outlet boxes from structural members, not ceiling members. Plastic inserts are not permitted. Supports for each fixture shall be capable of supporting four times fixture weight.

- W. At acceptance of the work, the Contractor shall clean all fixtures.
- X. Cables shall be installed in accordance with the requirements of NFPA 70. If paving or Railroad track is already in place wrought-iron or galvanized steel pipes shall be driven under it. Where rigid steel conduit installed underground without concrete encasement is indicated, the conduit shall have a factory-applied coating with minimum thickness not less than the following:
 - 1. Low-density or medium-density plastic 0.040-inch
 - 2. Epoxy resin 0.08-inch
 - 3. Coal-tar enamel 0.63-inch

3.2 FIELD TESTS AND INSPECTIONS

- A. Perform all field tests and provide all labor, equipment, and incidentals required for testing, except when the client will provide electric power required for field tests when available.
- B. After installation has been completed, the Contractor shall conduct an operating test. The equipment shall be demonstrated to operate in accordance with the requirements of this Section.
- C. Show by demonstration in service that circuits, fixtures, and equipment are in good operating condition. Tests shall be such that each piece of control equipment shall function not less than 5 times. The Contractor shall give the Engineer 5 days advance notice of the dates and times for tests and inspections.
- D. Interior installations shall be tested for insulation resistance after all wiring is completed and connected, ready for the attachment of fixtures and equipment, and again when fixtures and equipment are connected, ready for use. All defective material and workmanship disclosed as the result of the tests given herein shall be corrected at no cost to the client. Demonstrate in service that all circuits and devices are in good operating condition.
- E. Deficiencies shall be rectified, and work affected by such deficiencies shall be completely retested at the Contractor's expense.

END OF SECTION 265600

SECTION 272133 - DATA COMMUNICATIONS WI-FI ACCESS POINTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. Amtrak Engineering Practice EP3014 "Maintenance and Protection of Railroad Traffic During Contractor Operations" applies to all contractor work on Amtrak right-of-way and adjacent to Amtrak tracks.
- D. The Work specified in this Section consists of furnishing and installing communication conduit and cables, power conduit and cables, to support the Wi-Fi system components wireless access points, network switches, and PoE switches as indicated.

1.2 RELATED DOCUMENTS

- A. Drawings

1.3 SUMMARY

- A. Section includes a stand-alone, onsite Wi-Fi system components consisting of: wireless access points, network switches, PoE switches and its associated equipment.

1.4 DEFINITIONS

- A. FO: Fiber Optic.
- B. FTP: File transfer protocol.
- C. IP: Internet protocol.

- D. LAN: Local area network.
- E. NTSC: National Television System Committee.
- F. POE: Power Over Ethernet
- G. TCP: Transmission control protocol - connects hosts on the Internet.
- H. UPS: Uninterruptible power supply.
- I. WAP: Wireless Access Points
- J. WI-FI: Wireless Fidelity
- K. WAN: Wide area network.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Wi-Fi system 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.

1.6 ACTION SUBMITTALS

- A. A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- C. Shop Drawings: For Wi-Fi system components 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. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
 - 3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.

4. UPS: Load requirements for sizing calculations.
 5. Wiring Diagrams: For power, signal, and control wiring.
 6. Room HVAC requirements.
- 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, and set points of adjustments.

1.7 INFORMATIONAL SUBMITTALS

- A. A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Seismic Qualification Certificates: For the Wi-Fi equipment supporting 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.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

1.8 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.
- B. Operation and Maintenance Data: For access points, network switches, PoE switches, power supplies, components to include in emergency, operation, and maintenance manuals. In addition to emergency, operation, and maintenance manuals include the following:
 1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

1.9 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01. **This is a sole source item and no substitutions will be allowed.**
- 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. Comply with NECA 1.
- D. Comply with NFPA 70.

1.10 PROJECT CONDITIONS

- A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
 - 1. 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 85 mph and snow cover up to 24 inches thick. Refer to drawings for enclosure type and requirements.
 - 2. Security Environment: Access point housing for use in high-risk areas where Communications equipment may be subject to physical violence.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.12 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the 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 Access Point equipment, equipment related to

Communications operation, and control-station equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. A single surface-mount or recessed box shall be specified at locations for wireless node connectivity. Each access point location shall contain two (2) data wires for connectivity. The locations may be specified on the underside of the station platform overhang as a surface-mount box or attached to the station platform lighting poles as indicated on the plan drawings.
- B. Coverage areas:
 1. All building spaces shall have coverage for currently supported Wi-Fi standards (this includes 802.11a/b/g/n/ac at a minimum SNR of 25dBm)
 2. Outdoor coverage around the station platform shall be provided for all high-user areas and where practical in other areas. Outdoor access points should be mounted to the underside of the station platform overhang and/or the station platform lighting pole. Refer to the plan drawings for installation height and spacing of devices.
 3. Density of communication outlets for WAPs:
 - a. Unique requirements:
 - 1) For areas where high end-device density is anticipated, special consideration for wireless coverage shall be examined.
 - a) Generally, 25 end-devices (not persons) per WAP.
 - b) As wireless technology rapidly evolves, changes to RF spectrum usage may trigger changes to WAP density and mounting.
 4. Proper installation and mounting of WAPs in these spaces may result in WAPs with moderate to high visibility. Mounting above a hard ceiling or below a hard floor or in proximity to metal building components, HVAC ducts, etc. can diminish the wireless signal beyond the tolerances for a high-density deployment.
 5. Cabling pathways to ceiling mount WAP locations as well floor or wall locations must be planned. Pathways are to be rigid conduit placed above ceiling, or in the wall.
 6. Cabling infrastructure:
 - a. Each communications data outlet for a WAP is to be served by two (2) category 6 or 6a outlets/cables, depending on the station structured cabling design.

- b. Cable locations/mounting will be designed for below ceiling and flush mounted WAPs. Any exceptions, such as high-density locations, shall be approved by Amtrak.
 - c. The outlet backbox shall be affixed to the structure.
- C. Patch Cords
- 1. Provide (1) 7' and (1) 1' patch cord. Patch cords can be coiled to reduce slack cordage. Cordage shall not be placed on top of ceiling tiles.
- D. 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's entry connection to components.
- 1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."
 - 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Section 264313 "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.

2.2 WIRELESS ACCESS POINT

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Wireless Access Points for station platform areas shall be Cisco Meraki model MR74. **This is a sole source item and no substitutions will be allowed.**
- 1. Radios:
 - a. 2.4 GHz 802.11b/g/n client access radio.
 - b. 5 GHz 802.11a/n/ac client access radio.
 - c. 2.4 GHz & 5 GHz WIDS/WIPS, spectrum analysis, and location analytics radio.
 - d. 2.4 GHz Bluetooth Low Energy (BLE) radio with Beacon and BLE scanning support.
 - e. Concurrent operations of all four radios.
 - f. Supported frequency bands (country-specific restrictions apply):
 - 1) 2.412-2.484 GHz
 - 2) 5.150-5.250 GHz (UNII-1)
 - 3) 5.250-5.350 GHz (UNII-2)

- 4) 5.470-5.600, 5.660-5.725 GHz (UNII-2e)
 - 5) 5.725 -5.825 GHz (UNII-3)
2. 802.11ac and 802.11n Capabilities:
 - a. 2 x 2 multiple input, multiple output (MIMO) with two spatial streams.
 - b. SU-MIMO and MU-MIMO support.
 - c. Maximal ratio combining (MRC) & Beamforming.
 - d. 20 and 40 MHz channels (2.4Ghz), 20, 40, and 80 MHz channels (5Ghz).
 - e. Up to 256 QAM on both 2.4 GHz and 5 GHz bands.
 - f. Packet aggregation.
 3. Power:
 - a. Power over Ethernet: 37 - 57 V (802.3af compatible).
 - b. Power consumption: 11 W max (802.3af).
 - c. Power over Ethernet injector sold separately.
 4. Mounting:
 - a. Mounts to walls and vertical poles.
 - b. Mounting hardware included.
 5. Physical Security:
 - a. Security screw included.
 6. Environment:
 - a. Operating temperature: -40 °F to 131 °F (-40 °C to 55 °C).
 - b. IP67 environmental rating.
 7. Physical Dimensions:
 - a. 10" x 6.2" x 2.6" (256 mm x 158 mm x 65 mm).
 - b. Weight: 2.4 lbs. (1.09 kg).
 8. Interfaces:
 - a. 1x 100/1000Base-T Ethernet (RJ45).
 - b. Four external N-type female antenna connectors.
 9. Security:
 - a. Integrated layer 7 firewall with mobile device policy management.
 - b. Real-time WIDS/WIPS with alerting and automatic rogue AP containment with Air Marshal.
 - c. Flexible guest access with device isolation.
 - d. VLAN tagging (802.1Q) and tunneling with IPSec VPN.
 - e. PCI compliance reporting.
 - f. WEP, WPA, WPA2-PSK, WPA2-Enterprise with 802.1X.
 - g. EAP-TLS, EAP-TTLS, EAP-MSCHAPv2, EAP-SIM.
 - h. TKIP and AES encryption.

- i. Enterprise Mobility Management (EMM) & Mobile Device Management (MDM) integration).
- 10. Quality of Service:
 - a. Advanced Power Save (U-APSD)
 - b. WMM Access Categories with DSCP and 802.1p support.
 - c. Layer 7 application traffic identification and shaping.
- 11. Mobility:
 - a. PMK, OKC, and 802.11r for fast Layer 2 roaming.
 - b. Distributed or centralized layer 3 roaming.
- 12. LED Indicators:
 - a. 1 power/booting/firmware upgrade status.
- 13. Regulatory:
 - a. RoHS.
 - b. For additional country-specific regulatory information, please contact Meraki sales.
- 14. Warranty:
 - a. 1-year hardware warranty with advanced replacement included.
- C. The Wireless Access Points shall be connected by CAT 6 4 pair 24 AWG Ethernet cable for locations less than 328 feet from the Communications Room.

2.3 EQUIPMENT RACK

- 1. See Specification 282301 – Video Surveillance System.

2.4 NETWORK SWITCH

- A. Network switch for the Wireless Access Point shall be Cisco Meraki model MS120-24P. **This is a sole source item and no substitutions will be allowed.**
- B. Capacity:
 - 1. Type: MAC forwarding entries
 - 2. Value: 16000
 - 3. Type: VLANs supported
 - 4. Value: 4094
- C. Dimensions & Weight:
 - 1. Depth: 9.8 in
 - 2. Height: 1.7 in

3. Weight: 8.18 lbs
 4. Width: 17.3 in
- D. Environmental Parameters:
1. Humidity Range Operating: 5 - 95% (non-condensing)
 2. Max Operating Temperature: 104 °F
 3. Min Operating Temperature: 32 °F
- E. Header:
1. Brand: Cisco Meraki
 2. Manufacturer: Meraki
 3. Model: MS120-24P
 4. Packaged Quantity: 1
 5. Product Line: Cisco Meraki Cloud Managed
- F. Interface Provided:
1. Connector Type: RJ-45
 2. Qty: 24
 3. Type: 1000Base-T
 4. Connector Type: SFP
 5. Qty: 4
- G. Miscellaneous:
1. Authentication Method: RADIUS
 2. Color Category: White
 3. Compliant Standards: CSA, FCC, IC, RCM, RoHS
 4. Height (Rack Units) : 1
 5. MTBF: 1,700,716 hours
 6. Rack Mounting Kit: Included
- H. Networking:
1. Compliant Standards: IEEE 802.1ab (LLDP), IEEE 802.1D, IEEE 802.1p, IEEE 802.1Q, IEEE 802.1w, IEEE 802.1x, IEEE 802.3ad (LACP), IEEE 802.3af
 2. Connectivity Technology: Wired
 3. Features: Access Control List (ACL) support, Auto-negotiation, Auto-uplink (auto MDI/MDI-X), Broadcast Storm Control, Cisco Discovery Protocol, Crossover detection, DHCP client, DHCP snooping, DSCP to CoS Mutation, E-mail alert, Fanless, Firmware upgradable, Flow control, IGMP snooping, Port mirroring, Quality of Service (QoS), Rapid Spanning Tree Protocol (RSTP) support, Role-Based Access Control (RBAC), Single Sign-On (SSO) support, SMS alert, Spanning Tree Protocol (STP) support, STP BPDU Guard, STP Root Guard, Syslog support, VLAN support, Zero-touch provisioning (ZTP)
 4. Form Factor: Desktop, Rack-mountable
 5. Jumbo Frame Support: 9578 bytes
 6. Manageable: Yes

7. PoE Budget: 370 W
8. Ports Qty: 24
9. Power Over Ethernet (PoE): PoE
10. Remote Management Protocol: SNMP
11. Subcategory: Network hubs and switches
12. Subtype: Gigabit Ethernet
13. Type: Switch

I. Performance:

1. Type: Forwarding rate
2. Value: 41.67 Mpps
3. Type: Switching capacity
4. Value: 56 Gbps

J. Ports:

1. Qty: 24
2. Type: 10/100/1000

K. Ports (2nd):

1. Qty: 4
2. Type: Gigabit SFP

L. Power Device:

1. Frequency Required: 47 - 63 Hz
2. Nominal Voltage: AC 120/230 V
3. Type: Internal power supply

M. Service:

1. Support Details Full Contract Period: Lifetime
2. Support Details Service Included: Advance parts replacement
3. Support Details Type: Limited warranty

N. Service & Support:

1. Type: Limited lifetime warranty

O. Service & Support Details:

1. Response Time: Next business day

2.5 UNINTERRUPTIBLE POWER SUPPLY (UPS):

1. See Specification 282301 – Video Surveillance System.

2.6 RACK MOUNTED POWER SUPPLIES

1. See Specification 282301 – Video Surveillance System.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to Wi-Fi installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN, WAN, and IP network before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. All underground utilities, cable, and facilities must be located and protected before any excavating, drilling, boring/directional drilling, ground penetrating activities, or construction takes place. This includes railroad and commercial utilities, cables, duct lines, and facilities. These activities will not be performed in close proximity to the Amtrak duct lines unless monitored by on-site Amtrak communications and signal (C&S) department personnel. Hand digging may be required, as directed by Amtrak through the on-site Amtrak C&S support personnel. Amtrak maintains the right to access all existing cables and conduits throughout construction. Amtrak also reserves the right to upgrade and install new cables and conduits in the affected area. The call before you dig 811 "one-call" process must be followed. Please note that Amtrak is not a part of the one-call process; contact Amtrak engineering to have all Amtrak underground utilities and assets located. If requested by Amtrak, existing depths of utilities being crossed must be verified through test pits performed by the contractor personnel. Hand digging may be required. Precautions must be taken to prevent any interruption to Amtrak's operation.

3.2 WIRING

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."
- B. Wiring Method: Install cables in RGS conduit unless otherwise indicated.
- C. 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.

- D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. 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-486B.
- E. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Adequate space and provisions shall be left for removal of components and servicing of equipment, with minimum inconvenience to the operation of systems.
- B. Communications Cabling shall not touch or be supported from piping, ductwork, conduits, ceiling supports or any other service / equipment. Communications Cabling shall be supported by approved j-hooks, cable slings, ladder / basket tray and/or conduit as outlined in this document.
- C. Identify system components, wiring, cabling, and terminals according to Section 260553 "Identification for Electrical Systems."

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. 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.

3.5 SITE CONDITIONS

- A. The Communications Contractor is responsible for maintaining a clean work environment and is responsible for the removal of all debris on a daily basis. Debris and removed materials shall be disposed of in conformance with all local by laws and regulations. Failing to comply and after reasonable time and written notice the General Contractor reserves the right to hire cleaners to complete the cleaning and back charge the Communications Contractor.

- B. The Communications Contractor shall be responsible for the removal and reinstallation of all floor or ceiling tiles, hatch ways or access panels. All items shall be removed and replaced on a daily basis and left in the original condition. Special caution shall be taken to not break, chip or discolour with dirt or finger prints any such items. The Communications Contractor will be fully responsible for repair or replacement of all damaged pieces at the discretion of the Project Manager or Client.
- C. All materials and installation throughout the project will remain the responsibility of the Communications Contractor until final completion for the project is accepted by the Client. Damages to any item installed shall be replaced or repaired by the Communications Contractor to provide a complete final installation at no additional cost to the Client.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to provide 8 hours on site to train Owner's maintenance personnel. The training shall include the following:
 - 1. An intensive course covering setup, retrieval, adjusting, operating, and maintaining video-surveillance equipment learning on the installed commissioned systems.

END OF SECTION 272133

SECTION 273226 - BLUE LIGHT / EMERGENCY TELEPHONE (BL/ETEL) SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. This Section specifies the minimum requirements for Blue Light/Emergency Telephone (BL/ETEL) System. This section includes Furnishing, installing, and testing new phones, cabling and connection to, miscellaneous equipment required for connectivity. Work shall include all necessary coordination to assure all BL/ETEL components, cabling and infrastructure are provided and installed (in conjunction with equipment provided by others) to provide a complete aesthetic and functional BL/ETEL system.
- D. The System shall be integrated with the Video Surveillance Systems as necessary to allow automatic camera call-up upon activation.
- E. Communication between blue light stations and Operations/Emergency Response Personnel shall be by the use of the blue light station per NFPA 130 and a PBX phone circuits.

1.2 RELATED ITEMS:

- A. Section 066100 "Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels".

1.3 SUBMITTALS:

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

- B. Product Data: All equipment shall conform to the requirements of the Amtrak Police Department Corporate Security – Guidance, Practices and Recommendations, latest revision.
- C. Shop Drawings: Include block diagrams, detail mounting locations, and rack layouts.
- D. Product Samples: The Designer will not make a color selection until it can be coordinated with other Division 9 color selections.

1.4 CLOSEOUT SUBMITTALS:

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE:

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01
- B. Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 817 Article 1.20-1.05.24 subsection 2.

1.6 DELIVERY, STORAGE, AND HANDLING:

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.7 WARRANTY:

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

PART 2 - PRODUCTS

2.1 BLUE LIGHT/EMERGENCY TELEPHONE (BL/ETEL) SYSTEM

- A. Low-voltage power, signal and data cabling is provided under Division 26. Coordinate all cabling size requirements to assure compatibility with equipment and installed by others.
- B. Use:

1. ETP-MTE Emergency Phone Tower by Talk A Phone, w/ blue light/strobe (10" x 6.75" x 112"), standard in blue color.
2. ETP-400 Hands-free, Single Button Emergency Phone with 2-ways communication – Outdoor rated.

2.2 EMERGENCY TELEPHONE (ETEL) UNIT:

- A. Coordinate with the Architect regarding equipment dimensions. Mounting requirements/locations, and cabling size requirements to assure that the BL/ETEL System infrastructure provided is compatible with the ETEL Unit.
- B. Activation of a BL/ETEL station by pushing the red button shall initiate communication to the Amtrak Police Department.

2.3 BLUE LIGHT (BL) UNIT

- A. Blue Light (BL) Unit to be provided as an integral part of the BL/ETEL System.
- B. The BL Unit shall be constantly illuminated and be located directly above the ETEL Unit per NFPA 130.

2.4 AUXILIAR INPUTS AND OUTPUTS

- A. Auxiliary input and outputs to integrate with CCTV, Blue Light Strobe and other devices.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL:

- A. Inspect all Blue Light/Emergency Telephone Station (BL/ETEL) System equipment for quality of installation and verify system performance in accordance with manufactures instructions.

3.2 TRAINING:

- A. Refer to Form 817 Article 1.20-1.08.14 subsection 3 for additional information.

END OF SECTION 273226

SECTION 274216 - PASSENGER INFORMATION DISPLAY (PID) SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. The Work specified in this Section consists of furnishing and installing communication conduit and cables, power conduit and cables, and LED matrix displays for the Passenger Information Display (PID) system as indicated in this specification and on the drawings

1.2 RELATED DOCUMENTS

- A. Drawings and Contract Terms and Conditions
- B. Amtrak Graphic Standard Signage Manual and Station Guidelines
- C. Requirements of the following Division 26 Sections apply to this Section:
 - 1. Common Work Results for Electrical - Section 260500.
 - 2. Low Voltage Electrical Power Conductors and Cables - Section 260519.
 - 3. Hangers and Support for Electrical Systems - Section 260529.

1.3 SUMMARY:

- A. This Section includes requirements for the Passenger Information Display systems.
- B. The Contractor shall furnish and install all LED matrix displays, cable and conduit associated with the PID systems including the PA/PID system head-end equipment enclosure within the Utility Room and make final terminations to this equipment.

1.4 SUBMITTALS:

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product data for each type of product specified.
- C. Maintenance data for materials and products, for inclusion in Operating and Maintenance Manual. Provide complete manual material concurrently with system submittal and provide updated final versions of manuals one month before completion of construction and final system turnover.

1.5 CLOSEOUT SUBMITTALS:

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE:

- A. Source limitations: Obtain products from multiple manufacturers.
- B. Electrical Component Standard: Provide work complying with applicable requirements of NFPA 70 "National Electrical Code", 2017.

1.7 DELIVERY, STORAGE AND HANDLING:

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.8 WARRANTY:

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

PART 2 – PRODUCTS

2.1 PASSENGER INFORMATION DISPLAY (PID):

- A. PID system LED matrix displays and visual messaging monitors shall be:
 - 1. Double Face: Daktronics Galaxy Model AF. The signs will be provided by the Owner and installed by the Contractor. .
 - 2. Single sided 46” LCD flat screen monitor, outdoor rated, pedestal mounted. These items will be procured and installed by the Contractor.
- B. PID cable shall consist of two 4 pair #23AWG solid copper conductors bonded in pairs within an overall foil shield. Belden # 7953A Cat 6/RS-422 cable or equal

- C. The PA/PID Head end equipment shall include all patch panels, network switches, Video transmitters and Audio amplifiers, necessary to provide a CT DOT/ Amtrak compliant working system.

PART 3 – EXECUTION

3.1 EXAMINATION:

- A. Examine conditions, with the Installer present, for compliance with requirements and other conditions affecting the performance of the system work.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. General: Install system in accordance with NFPA 70/2017 and other applicable codes.
- B. In accordance with Section 260533 "Raceways and Boxes for Electrical Systems."

3.3 TESTING:

- A. Perform all PA and PID system field tests and provide all labor, equipment, and incidentals required for testing.
- B. After installation has been completed, the Contractor shall conduct an operating test of the PA/PID system to demonstrate it operates in accordance with the requirements of this Section.
- C. The Contractor shall show by demonstration in service that circuits and field devices are in good operating condition. The Contractor shall give the Engineer 5 days advance notice of the dates and times for tests and inspections.
- D. All defective material and workmanship disclosed as the result of the tests given herein shall be corrected at no cost to the owner.

3.4 CLEANING AND PROTECTION:

- A. Prior to final acceptance, clean system components and protect from damage and deterioration.

END OF SECTION 274216

SECTION 275116 – PUBLIC ADDRESS SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.
- C. The Work specified in this Section consists of furnishing and installing communication conduit, cables and speakers for the Public Address (PA) system as shown on drawings.

1.2 RELATED DOCUMENTS

- A. Drawings and Contract Terms and Conditions
- B. Amtrak Graphic Standard Signage Manual and Station Guidelines
- C. Requirements of the following Division 26 Sections apply to this Section:
 - 1. Common Work Results for Electrical - Section 260500.
 - 2. Low Voltage Electrical Power Conductors and Cables - Section 260519.
 - 3. Hangers and Support for Electrical Systems - Section 260529.

1.3 SUMMARY:

- A. This Section includes Amtrak requirements for the Public Address systems.
- B. The Contractor shall furnish and install all speakers, cable and conduit associated with the PA systems including the PA/PID system head-end equipment enclosure within the Telecom Room and make final terminations to this equipment.

1.4 SUBMITTALS:

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

- B. Product data for each type of product specified.
- C. Maintenance data for materials and products, for inclusion in Operating and Maintenance Manual. Provide complete manual material concurrently with system submittal and provide updated final versions of manuals one month before completion of construction and final system turnover.

1.5 CLOSEOUT SUBMITTALS:

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE:

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Electrical Component Standard: Provide work complying with applicable requirements of NFPA 70 "National Electrical Code".

1.7 DELIVERY, STORAGE AND HANDLING:

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.8 WARRANTY:

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

PART 2 – PRODUCTS

2.1 PUBLIC ADDRESS SYSTEMS:

- A. PA system speakers shall be grey baked epoxy double re-entrant type with compression driver mounted within a Flange weather-resistant housing. Audio power capability shall be 15 Watts continuous. Transformer-equipped loudspeaker shall have impedance selection position switch. Power taps shall be available on 70.7V line. Loudspeaker mounting shall be as shown on drawings.
 - 1. Interior: Atlas Sound Model APF-15T with Model L20-100 grille.
 - 2. Exterior: Atlas Sound Model APF-15T installed in Model VP410-S vandal-proof enclosure with FAMT-6 adapter plate.
- B.
 - 1. Speaker wire shall be two #18 AWG high conductivity copper conductors such as Belden # 8460 or equal.

- C. 1. Multi-channel, amplified monitor panel shall be Atlas Sound Model MVXA-2008 or MVXA-2016 or approved equal. Unit shall be capable of visually monitoring 8 or 16 channels simultaneously. Independent aural monitoring of each channel shall be provided by an internal speaker, a headphone jack, a 3-watt speaker level output, and a line level output to drive an external amplifier. It shall be able to monitor any combination of line level, inputs. It shall feature standard E.I.A.

PART 3 – EXECUTION

3.1 EXAMINATION:

- A. Examine conditions, with the Installer present, for compliance with requirements and other conditions affecting the performance of the system work.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. General: Install system in accordance with NFPA 70/2017 and other applicable codes.
- B. In accordance with Section 260533 "Raceways and Boxes for Electrical Systems."

3.3 TESTING:

- A. Perform all PA system field tests and provide all labor, equipment, and incidentals required for testing the PA/PID equipment.
- B. After installation has been completed the Contractor shall demonstrated the PA and PID systems operate in accordance with the requirements of this
- C. The Contractor shall show by demonstration in service that circuits and field devices are in good operating condition. The Contractor shall give the Engineer 5 days advance notice of the dates and times for tests and inspections.
- D. All defective material and workmanship disclosed as the result of the tests given herein shall be corrected at no cost to the owner.

3.4 CLEANING AND PROTECTION:

- A. Prior to final acceptance, clean system components and protect from damage and deterioration.

END OF SECTION 275116

SECTION 282301 - VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.
- C. The Work specified in this Section consists of furnishing and installing communication conduit and cables, power conduit and cables, and cameras for the Video Surveillance System (VSS) as indicated.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2004 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the Amtrak Police Department Corporate Security – Guidance, Practices and Recommendations 2011 rev 3 and specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.

1.3 SUMMARY

- A. Section includes a stand alone, onsite video surveillance recording system consisting of IP Megapixel digital cameras, digital network video recorder, data transmission wiring, and a control station with its associated equipment.

1.4 DEFINITIONS

- A. AGC: Automatic gain control.
- B. BNC: Bayonet Neill-Concelman - type of connector.
- C. FO: Fiber Optic.
- D. FTP: File transfer protocol.
- E. IP: Internet protocol.
- F. LAN: Local area network.
- G. MPEG: Moving picture experts group.
- H. NTSC: National Television System Committee.
- I. TCP: Transmission control protocol - connects hosts on the Internet.
- J. UPS: Uninterruptible power supply.
- K. WAN: Wide area network.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Video surveillance system 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.

1.6 ACTION SUBMITTALS

- A. A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- C. Shop Drawings: For video surveillance. 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. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.
 3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.
 4. UPS: Load requirements for sizing calculations.
 5. Wiring Diagrams: For power, signal, and control wiring.
 6. Room HVAC requirements.
- 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.

1.7 INFORMATIONAL SUBMITTALS

- A. A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Seismic Qualification Certificates: For video surveillance, cameras, camera-supporting 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.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

1.8 CLOSEOUT SUBMITTALS

- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.
- B. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to emergency, operation, and maintenance manuals include the following:
 - 1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

1.9 QUALITY ASSURANCE

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 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. Comply with NECA 1.
- D. Comply with NFPA 70.

1.10 PROJECT CONDITIONS

- A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
 - 1. 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 85 mph and snow cover up to 24 inches thick. Refer to drawings for enclosure type and requirements.
 - 2. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.12 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the 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: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. Video-signal format shall comply with NTSC standard, composite interlaced video.
- 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's entry connection to components.
 - 1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."
 - 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Section 264313 "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.

2.2 CAMERAS

- A. Cameras for Platform/Utility Building areas shall be Axis model Q3515-LVE or equivalent (see source limitations below) meeting the following requirements:
 - 1. Be compatible with all the other stations on NHHS Line (including Berlin, Meriden and Wallingford) that use Pelco Digital Sentry System.

2. Camera Image Sensor: 1/2.8" Progressive Scan RGB CMOS, IR-sensitive
3. Lens: Varifocal, Remote focus & zoom, IR-corrected, P-iris control
 - 9 mm: 3-9 mm, F1.3
 - Horizontal field of view: 105°-36°
 - Vertical field of view: 57°-21°
 - 22 mm: 9-22 mm lens, F1.6
 - Horizontal field of view: 33°-15°
 - Vertical field of view: 19°-9°
4. Zoom: 3x (optical); 2x (digital)
5. Minimum Illumination: Color: 0.18 lx at F1.3 (1080p, 30fps, with WDR)
B/W: 0.04 lx at F1.3 (1080p, 30fps, with WDR)
6. Day/Night: Automatically removable infrared-cut filter
7. Wide Dynamic Range (WDR): Up to 120dB
8. Shutter Time: 1/66500 s to 2 s
9. Video Compression: H.264 (MPEG-4 Part 10/AVC) Baseline, Main and High Profiles
Motion JPEG
10. Resolutions: 1920x1080 to 160x90
11. Frame Rate: Up to 50/60 fps with WDR. Up to 100/120 fps without WDR at 1080p resolution.
12. Video Streaming: Multiple, individually-configurable streams in H.264 and Motion JPEG
 - Axis Zipstream technology in H.264
 - Controllable frame rate and bandwidth
 - VBR/ MBR H.264
13. Supported Protocols: IPv4/v6, USGv6, SSL/TLS, QoS Layer 3 DiffServ, TCP, SFTP, CIFS/SMB, Bonjour, UPnP, SNMP v1/v2c/v3 (MIB-II), DynDNS, UDP, IGMP, ICMP, NTP, RTSP, HTTP, HTTPS, FTP, SMTP, DNS, SOCKS, SSH, RTP, RTCP, DHCP, ARP, LLDP
14. Camera ID: Up to 20 characters (alphanumeric characters, marks)
15. Network Interface: 10Base-T/100Base-TX PoE, RJ-45 connector

16. Inputs and Outputs: 2 configurable supervised I/O ports, accessible via terminal block. Configurable normally open or normally closed
17. Power: Power over Ethernet (PoE) 802.3af/802.3at Type 1 Class 3, typical 5.6W, max 12.5W max.

8–28VDC, typical 6.3W, max 13.6W

Power redundancy

18. Memory: 1 GB RAM, 512 MB Flash
19. API: Open API for software integration
20. ONVIF Profile S
21. Event Triggers: Analytics, supervised external inputs, virtual inputs through API, , edge storage events, shock detection
22. Image Settings: Electronic image stabilization, white balance (auto and manual), backlight compensation, image rotation (90degree increments), low light compensation, exposure control, privacy masks
23. Video Transmission: HTTP (Unicast), HTTPS (Unicast), RTP (Unicast & Multicast), RTP over RTSP (Unicast), RTP over RTSP over HTTP (Unicast)
24. Environmental: -40°C to +60°C (-40°F to +140°F), 10-100% RH (condensing)
25. EMC Approvals: FCC Part 15 - Subpart B Class A + B
26. Railroad EMC Approvals: EN 55032 Class A, EN 50121-4, IEC 62236-4
27. EN 55024, IEC/EN 61000-6-1, IEC/EN 61000-6-2,
28. Safety Approvals: IEC/EN/UL 62368-1, IEC/EN/UL 60950-22, IEC/EN 62471
29. Environmental Approvals: IEC 60068-2-1, IEC 60068-2-6, IEC 60068-2-14, IEC 60068-2-27, IEC 60068-2-78
30. MTBF: >100,000 hours

- B. The camera shall be an outdoor, vandal-resistant network dome camera designed for 24/7/365 use. The enclosure shall include a polycarbonate and aluminum body with encapsulated electronics, weather shield for vertical installations, and meet the requirements of IEC/EN 60529 IP66/67, NEMA 250 Type 4X, and IEC/EN 62262 IK10+ (50 J). Enclosure shall provide the ability to adjust the camera modules angle with $\pm 80^\circ$ tilt, $\pm 360^\circ$ pan and $\pm 175^\circ$ rotation while maintaining an image that is not interfered by the camera housing. Enclosure shall be equipped with a dehumidifying membrane.

- C. The camera shall feature a black and white mode that may be automatically engaged on low light level and permit the use of an external infrared illuminator or manually selected. The camera shall incorporate independent automatic color-to-black and white switching modes for switchover on light threshold and sensitivity to IR illumination. Automatic color-to-black and white switching shall have selectable light level thresholds (high or low) and duration settings for the selected threshold before automatic switchover occurs.
- D. The cameras located under 300ft shall be connected by PoE cables.
- E. Remote cameras shall be connected by CAT 6 4 pair 24 AWG Ethernet cable.

2.3 CCTV Software Licenses:

The Contractor shall supply the following items of CCTV software licenses to meet the requirements as shown in the plans. These CCTV licenses shall be purchased with the NVR.

Pelco Part Number	Description
VXP-1C-3Y	VideoXpert™ Professional 1CH LICENSE + 3YR SUP For 1CH

Furnish licenses for every camera integrated into the system as part of the Contract.

2.4 EQUIPMENT RACK

- A. Provide a free standing rack to house surge suppressor, Media Converter, Network switch NVR Server/DVD burner, power supply, fold out keyboard and 17”LCD monitor.
- B. Rack shall be a slide-out type 70”high, 40” deep, 24”wide, nominal and include 40 rack units.
- C. Provide service light, vertical power strip (entire height of rack), and cable management ladder.
- D. Provide cooling fans and temperature monitor with a thermostat.
- E. Provide Fiber Distribution Panel (FDP) 24-position for fiber optic connectivity

2.5 NETWORK SWITCH

- A. Cisco IE 5000 Series or equal.

B. Product Description:

Cisco Part Number	Description	Quantity
IE-5000-12S12P-10G	Rugged Industrial Ethernet switch w/ (4) 1/10 Gigabit Ethernet (GigE) SFP/SFP+ Ports, 12 10/100/1000 PoE/PoE+ ports, and 12 SFP Gigabit Ethernet (GigE)	1
PWR-RGD-AC-DC-250	High-Voltage AC/DC Power Source, 250W	1
SFP-10G-ER	10GBASE-ER 1550nm SMF	1
L-IE5000-RTU	Cisco IE 5000 IP Services License	1
CAB-CONSOLE-USB	Cisco Console Cable 6 ft. USB Type A to Mini-B	1
CON-SNT-IES12P50	SMARTNET Warranty Service, 8x5x Next Business Day	1*

*SMARTNET support shall be provided for 2 years for each switch

The rack shall be equipped with fiber to copper 100 Mb media converters with the following features:

1. AC powered Fiber Media Converter for multi-mode and single-mode fiber connector types to copper Ethernet for outdoor environments.

2.6 UNINTERRUPTIBLE POWER SUPPLY (UPS):

- A. An external UPS circuit shall be provided sized to provide 90 minutes operation of the security system under normal operating conditions (recording).
- B. Provide all load information for UPS sizing calculations, including each piece of security equipment, to support same equipment for 90 minutes.

2.7 RACK MOUNTED POWER SUPPLIES

- A. Provide two rack mounted power supplies Pelco RCS series or equal to power the cameras. Power supply shall have the following features:
 1. 26 volt output AC.
 2. Main LED indicator
 3. Self resetting circuit breakers.
 4. Removable terminal strips with clamp down connectors.

2.8 NETWORK VIDEO RECORDERS: Pelco or Equal

- A. The NVR shall a Microsoft Windows-based full-featured Video Management System (VMS) consisting in a single server performing the following functions:
1. Allow users to define users and assign sets of permissions (known as roles) to each user.
 2. Record and store video per user-defined retention settings for up to 96 cameras per server
 3. Serve live and recorded video to clients on demand
 4. The system shall record video and audio streams from IP cameras and video encoders on the network.
 - a. Video: MPEG4, MJPEG, H.264, or H.265 in High, Main, or Base Profile streams from both standard resolution and megapixel cameras
 - b. Audio: Bidirectional, full or half duplex compressed via G.711 PCM 8 bit, 8khz mono at 64 kbit/s.
 5. The system shall support recording schedules, including the ability to record based on motion, analytic, and alarm events.
 6. The system shall be capable of continuous scheduled alarm/event and motion recording. Pre- and post- alarm recording shall also be available and shall be fully programmable on a per channel basis.
 7. The system shall have the ability to record and playback audio streams along with associated video.
 8. The System shall support recording of primary or secondary streams, individually or simultaneously. The server application can be configured to record a stream in unicast or multicast.
 9. The System shall support video bookmarking, such that users can identify and recall important moments in recorded video based on the bookmark name or notes that are associated with it.
 10. The system shall allow the administrator to set minimum and maximum retention periods for recorded video.
 11. The system shall support network health and monitoring utilizing third-party SNMP monitoring tools.
 12. The system shall indicate system performance and operation status utilizing a variety of reports.
 13. The system shall be configurable remotely or over a network.
 14. The system shall discover both Pelco and third-party cameras on the network.
 15. The system shall allow users to manually add cameras and devices by IP address or DNS hostname.
 16. The system shall allow users with sufficient rights to control cameras (pan, tilt, and/or zoom).
 17. The system shall support aggregation by a higher-level system, tying multiple servers together in a single, unified environment.
 18. The system shall support third-party cameras using ONVIF profile S or native drivers.

19. The system shall support Lightweight Directory Access Protocol (LDAP) to authenticate users.
 20. The system shall allow archival of video data to external network locations or NAS devices over a network connection. The archival schedule shall be either automatic at user-defined intervals or manually executed.
 21. The system shall be available as a hardware server with capacity to record up to 96 cameras at up to 450 Mbps recording throughput (per recorder).
 22. The system shall support semantic grouping and organization of cameras/devices into groups using “tags”.
 23. The system shall allow users to export video on request; exported video shall be stored locally on the server or on another network location selected by the administrator.
 24. The system shall support aggregation by a higher-level environment, allowing the IP video management system to belong to a confederation of servers.
 25. The system shall be accessible via a web browser with no software installed for live and playback functionality.
- B. The NVR shall be in current manufacturing production and meet or exceed the latest VMS system manufacturer’s recommended specifications at the time of procurement and the following:
1. Processor: Intel® Xeon® Silver 4110
 2. Operating System: Microsoft Windows 10 IoT Enterprise 64-bit (LTSC)
 3. OS Drive: 2x SSD 240 GB (RAID 1)
 4. RAM: 16 GB DDR4
 5. HDD:
 - i. Maximum Storage: Up to 96 TB (7200 RPM SATA) (depending on model)
 - ii. RAID Level: RAID5 / RAID6 / JBOD (depending on model)
 6. Video
 - i. Outputs: 4x Mini DisplayPort 1.4
 - ii. Maximum Video Resolution Per Output Type
 1. mDP 1.4 direct connect HDR 5120 x 2880 at 60 Hz (30-bit color)
 7. Audio
 - i. Outputs DisplayPort Audio
 - ii. Connector Types mDP Cable (out)
 8. iDRAC controller
 - i. Dell iDRAC9 Basic
 9. USB Ports:
 - i. USB 2.0 1x Front
 - ii. USB 3.0 2x Rear
 10. Networking:
 - i. Gigabit Ethernet (1000Base-T) Ports 2x + Dedicated iDRAC port
 - ii. Throughput Up to 450 Mbps
 - iii. IP version IPv4 and IPv6
 11. Power

- i. Input 100 to 240 VAC 50/60 Hz, autoranging
 - ii. Supply Dual Hot Swappable 750 W (Platinum)
 - iii. Consumption 2891 BTU/hr maximum
- 12. Environmental:
 - i. Temperature
 - Operating 10° to 35°C (50° to 95°F)
 - Storage -40° to 65°C (-40° to 149°F)
 - ii. Operating Humidity 10% to 80% RH with 29°C (84.2°F)
- 13. Physical
 - i. Dimensions: 26.8 x 17.1 x 3.4 in
 - ii. Rack Mounting 2 RU

C. The NVR shall be provided with a minimum of 48TB storage.

Pelco Part Number	Description
VXP-P2-48-6-D	A. VXP 2nd Gen Power Series 48TB (6x8TB HDD) RAID6 Mirrored OS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.
- B. Examine roughing-in for LAN, WAN, and IP network before device installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."
- B. Wiring Method: Install cables in RGS conduit unless otherwise indicated.

- C. 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.
- D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. 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-486B.
- E. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.3 VIDEO SURVEILLANCE SYSTEM INSTALLATION

- A. Install cameras and infrared illuminators level and plumb.
- B. Install cameras with 84-inch minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.
- C. Set final camera position and to obtain the field of view required for camera. Connect all controls and alarms and adjust.
- D. Avoid ground loops by making ground connections only at the control station.
- E. Identify system components, wiring, cabling, and terminals according to Section 260553 "Identification for Electrical Systems."

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. 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.
- C. Tests and Inspections:
 - 1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

2. 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:
 - a. Prepare equipment list described in "Informational Submittals" Article.
 - b. Verify operation of auto-iris lenses.
 - c. Set back-focus of fixed focal length lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.
 - d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.
 - e. Set and name all preset positions; consult Owner's personnel.
 - f. Set sensitivity of motion detection.
 - g. Connect and verify responses to alarms.
 - h. Verify operation of control-station equipment.
 3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
 4. 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.
- D. Video surveillance system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. 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's use of video surveillance system.
5. Provide a written report of adjustments and recommendations.

3.6 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.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to provide 8 hours on site to train Owner's maintenance personnel. The training shall include the following:
 1. An intensive course covering setup, retrieval, adjusting, operating, and maintaining video-surveillance equipment learning on the installed commissioned systems.

END OF SECTION 282301

SECTION 283101 – FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY:

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled “SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY” and other Amtrak Specifications contained in the Contract.
- C. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.
- D. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.
- E. The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:
 - 1. Fire alarm and detection operations.
 - 2. Control and monitoring of elevators, fire suppression systems, emergency power systems, and other equipment as indicated in the documents.
 - 3. One-way supervised automatic voice alarm operations.
 - 4. Manual public address

1.2 ACCEPTABLE MANUFACTURERS:

- A. Manufacturers:
 - 1. Subject to compliance with specification requirements, suitable products by one of the following manufacturers will be considered by Engineer:
 - a. Simplex Grinnell or approved equal
- B. Being listed as an acceptable Manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.

- C. The Manufacturer, or its approved representative shall employ factory trained and NICET certified technicians and shall maintain a service organization within 30 miles of this project location. The Manufacturer and service organization shall have a minimum of 10 years experience in the fire protective signaling systems industry.

1.3 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:
 - 1. Division 26: "Basic Electrical Materials and Methods."
- C. The system and all associated operations shall be in accordance with the following:
 - 1. Guidelines of the following Building Code: Building Code of the State of Connecticut
 - 2. NFPA 72, National Fire Alarm Code
 - 3. NFPA 70, National Electrical Code
 - 4. NFPA 70E, Electrical Safety Requirements for Employee Workplaces
 - 5. NFPA 101, Life Safety Code
 - 6. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems
 - 7. FM Global approved Fire Alarm Control Panel as well as all associated signal and notification devices.
 - 8. Local Jurisdictional Adopted Codes and Standards
 - 9. ADA Accessibility Guidelines

1.4 SYSTEM DESCRIPTION:

- A. General: Provide a complete, non-coded, addressable microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.
- B. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory. System shall be capable of storing dual configuration programs with one

active and one in reserve. Panel shall be capable of full system operation during a new configuration download. The fire alarm manufacturer shall provide all software.

- C. History Logs: The system shall provide a means to recall incoming alarms and trouble conditions, as well as a history of when alarms have been cleared in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.
- D. Wiring/Signal Transmission:
 - 1. Transmission shall be hard-wired, using addressable signal transmission, dedicated to fire alarm service only.
 - 2. System connections for initiating circuits and notification appliance circuits shall be Class B.
 - 3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone and alphanumeric annunciation.
- E. Required Functions: The following are required system functions and operating features:
 - 1. Priority of Signals: Alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.
 - 2. Non-interfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACP after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent activations.
 - 3. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and the remote annunciator.
 - 4. General Alarm: A system general alarm shall include:
 - a. Identification of the device or zone that is the source of the alarm at the FACP.
 - b. Operation of audible and visible notification devices throughout the building until silenced at FACP.

- c. Shutting down supply and return fans serving zone where alarm is initiated.
 - d. Initiation of smoke control sequence through the existing building management control system shall not be affected by the fire alarm panel control functions.
 - e. Notifying the local 911 service using a dial-up modem
 - f. Initiation of elevator recall in accordance with ASME/ANSI A17.1, when specified detectors or sensors are activated.
5. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible alarm signals shall cease operation.
6. System Reset
- a. The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-arming the system. The display message shall indicate, "ALARM PRESENT, SYSTEM RESET ABORTED."
 - b. Should an alarm condition continue, the system will remain in an alarmed state.
7. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.
8. WALKTEST: The system shall have the capacity of 8 programmable passcode protected one-person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:
- a. The city circuit connection and suppression release circuits shall be bypassed for the testing group.
 - b. Control relay functions associated to one of the 8 testing groups shall be bypassed.
 - c. The control unit shall indicate a trouble condition.
 - d. The alarm activation of any initiation device in the testing group shall cause the audible notification appliances to sound a voice announcement to identify the device or zone.
 - e. The unit shall automatically reset itself after signaling is complete.
 - f. Any momentary opening of an initiating or notification appliance circuit wiring shall cause the audible signals to voice announce the trouble condition.

F. Analog Smoke Sensors:

1. Monitoring: FACP shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.
2. Environmental Compensation: The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.
3. Programmable Sensitivity: Photoelectric Smoke Sensors shall have 7 sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACP.
4. Sensitivity Testing Reports: The FACP shall provide sensor reports that meet NFPA 72 calibrated test method requirements. The reports shall be viewed on a CRT Display or printed for annual recording and logging of the calibration maintenance schedule.
5. The FACP shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to indicate that a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate that a sensor is close to a trouble reporting condition and will be indicated on the FACP as "ALMOST DIRTY." This condition provides a means to alert maintenance staff of a dirty sensor without creating a trouble in the system. If this indicator is ignored, a second level "DIRTY SENSOR" condition shall be indicated at the FACP and subsequently a system trouble is reported [to the Central Monitoring Station]. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended, and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control unit.
 - a. The FACP shall continuously perform an automatic self-test on each sensor, which will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.
6. Multi-Sensors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.2 to 3.7 %/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.

7. Programmable bases. It shall be possible to program relay and sounder bases to operate independently of their associated sensor.
 8. Magnet test activation of smoke sensors shall be distinguished by its label and history log entry as being activated by a magnet.
- G. Audible Alarm Notification: By voice evacuation and tone signals on loudspeakers in areas as indicated on drawings.
1. Automatic Voice Evacuation Sequence:
 - a. The audio alarm signal shall consist of an alarm tone for a maximum of five seconds followed by an automatic digital voice message. At the end of the voice message, the alarm tone shall resume. This sequence shall sound continuously until the "Alarm Silence" switch is activated.
 - b. All audio operations shall be activated by the system software so that any required future changes can be facilitated by authorized personnel without any component rewiring or hardware additions.
- H. Speaker: Speaker notification appliances shall be listed to UL 1480.
1. The speaker shall operate on a standard 25VRMS or 70.7VRMS NAC using twisted/shielded wire.
 2. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.
 3. The speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for General Signaling.
- I. Manual Voice Paging
1. The system shall be configured to allow voice paging. Upon activation of any speaker manual control switch, the alarm tone shall be sounded over all speakers in that group.
 2. The control panel operator shall be able to make announcements via the push-to-talk paging microphone over the pre-selected Switch/LED modules to accommodate the following zoned paging:
 - a. All Call
 - b. 1st floor
 - c. 2nd floor

3. The pre-recorded voice messaging throughout the building shall be the same message.

J. Power Requirements:

1. The control unit shall receive AC power via a dedicated circuit breaker.
2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 4 hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
3. All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control unit.
4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously while incoming power is present.
5. The system batteries shall be supervised so that a low battery or depleted battery condition or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.
6. The system shall support NAC Lockout feature to prevent subsequent activation of Notification Appliance Circuits after a Depleted Battery condition occurs in order to make use of battery reserve for front panel annunciation and control
7. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.

K. Ancillary Functions:

1. The fire alarm control panel shall have programmable LED's that include (1) Yellow status indicator light that shall allow the following:
 - a. City Disconnect
 - b. Fan-shut down bypass
 - c. Elevator recall
 - d. (4) Spare

1.5 SUBMITTALS:

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
 - B. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.
 - C. Wiring schematics from manufacturer.
 - D. Shop drawings showing system details including location of FACP, all devices, circuiting and details of LCD annunciator.
 - E. System Power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.
 - F. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, NAC, relay, sensor, and auxiliary control circuits.
 - G. Operating instructions for FACP/EVACS.
 - H. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.
 - I. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.
- 1.6 CLOSEOUT SUBMITTALS:
- A. Submit closeout submittals in accordance with Form 817 Article 1.20-1.05.02, NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.
- 1.7 QUALITY ASSURANCE:
- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01

- B. Installer Qualifications: A factory-authorized installer is to perform the work of this section.
- C. Each and all items of the Fire Alarm System shall be FM Global approved and listed as a product of a single fire alarm system manufacturer under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the "UL" label.
- D. Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 817 Article 1.20-1.05.24 subsection 2.

1.8 DELIVERY, STORAGE AND HANDLING:

- A. Refer to Form 817 Article 1.06.03 and Form 817 Article 1.20-1.06.03 for additional information.

1.9 WARRANTY:

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.

PART 2 - PRODUCTS

2.1 FIRE ALARM CONTROL PANEL (FACP):

- A. General: Comply with UL 864, "Control Units for Fire-Protective Signaling Systems" and FM Global 3010 as well as Data sheets 5-40.
- B. The following FACP hardware shall be provided:
 1. Power Limited base panel with red cabinet and door, 120 VAC input power.
 2. 200 point capacity where (1) point equals (1) monitor (input) or (1) control (output).
 3. 200 points of Network Annunciation at FACP Display when applied as a Network Node
 4. 200 points of annunciation where one (1) point of annunciation equals:
 - a. 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
 - b. 1 LED on panel or 1 switch on panel.
 5. From all battery charging circuits in the system provide battery voltage and ammeter readouts on the FCP LCD Display.
 6. Modem connection to municipal 911 service.

7. One Auxiliary electronically resettable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.
 8. One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
 9. Where required provide Intelligent Remote Battery Charger for charging up to 110Ah batteries.
 10. Power Supplies with integral intelligent Notification Appliance Circuit Class B for system expansion.
 11. Four (4) form "C" Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory of other fire response functions. Relays shall be capable of switching up to ½ A @ 120VAC, inductive.
 12. The FACP shall support (6) RS-232-C ports and one service port.
 13. Service Port Modem for dial in passcode access to all fire control panel information.
- C. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.
- D. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.
- E. Voice Alarm: Provide an emergency communication system, integral with the FACP, including voice alarm system components, microphones, amplifiers, and tone generators. Features include:
1. Amplifiers comply with UL 1711, "Amplifiers for Fire Protective Signaling Systems." Amplifiers shall provide an onboard local mode temporal coded horn tone as a default backup tone. Test switches on the amplifier shall be provided to test and observe amplifier backup switchover. Each amplifier shall communicate to the host panel amplifier and NAC circuit voltage and current levels for display on the user interface.
 2. Dual alarm channels permit simultaneous transmission of different announcements to different zones or floors automatically or by use of the central control microphone. All announcements are made over dedicated, supervised communication lines. All risers shall support Class B wiring for each audio channel.
 3. Eight channel digitally multiplexed audio for systems that require more than two channels of simultaneous audio. Up to 8 channels of audio shall be multiplexed on a style 4 twisted pair.

4. Emergency voice communication audio controller module shall provide up to 32 minutes of message memory for digitally stored messages. Provide supervised connections for master microphone and 1 remote microphone.
 5. Status annunciator indicating the status of the various voice alarm speaker zones and the status of fire fighter telephone two-way communication zones.
- F. Distributed Module Operation: FACP shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 Class B supervised serial communications channel (SLC):
1. Amplifiers, voice and telephone control circuits
 2. Addressable Signaling Line Circuits
 3. Initiating Device Circuits
 4. Notification Appliance Circuits
 5. Auxiliary Control Circuits
 6. Graphic Annunciator LED/Switch Control Modules

2.2 EMERGENCY POWER SUPPLY:

- A. General: Components include battery, charger, and an automatic transfer switch.
- B. Battery: Sealed lead-acid. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 4 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 15 minutes.

2.3 ADDRESSABLE MANUAL PULL STATIONS:

- A. Description: Addressable single- or double-action type, red LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.
- B. Protective Shield: Provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. Lowering and realigning the shield shall silence the horn. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery. Provide and install pull stations as shown on the drawings.

2.4 SMOKE SENSORS:

- A. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
1. Factory Nameplate: Serial number and type identification.
 2. Operating Voltage: 24 VDC, nominal.
 3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
 4. Plug-In Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit.
 5. Each sensor base shall contain an LED that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.
 6. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.
 7. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.
 8. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.
 9. Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Sensor address shall be located in base to eliminate false addressing when replacing sensors.
 10. Removal of the sensor head for cleaning shall not require the setting of addresses.
- B. Type: Smoke sensors shall be of photoelectric. Where acceptable per manufacturer specifications, ionization type sensors may be used.
- C. Bases: Relay output, sounder and isolator bases shall be supported alternatives to the standard base.
- D. Duct Smoke Sensor: Photoelectric type, addressable, sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor includes relay as required for fan shutdown.

1. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.
2. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.
3. Duct Housing shall provide a relay control trouble indicator Yellow LED.
4. Compact Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
5. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
6. Duct sensor shall be housed in a separate weatherproof gasketed enclosure.

2.5 HEAT SENSORS:

- A. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting unless noted as 200 – deg F fixed on plans.
- B. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.
- C. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.
- D. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.
- E. Provide where indicated on drawings, Fixed temperature detectors in mechanical rooms or other hazardous areas. Provide rate-of-rise detectors for storage rooms.

2.6 ADDRESSABLE CIRCUIT INTERFACE MODULES:

- A. Addressable Circuit Interface Modules: Arrange to monitor one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of non-addressable devices, and for control of evacuation indicating appliances and AHU systems.

- B. Addressable Circuit Interface Modules will be capable of mounting in a standard 4"x4"x1-1/2" electric outlet box. Modules will include cover plates to allow surface mounting. Modules will receive their operating power from the signaling line or a separate two wire pair running from an appropriate power supply as required. Cover plates shall be provided by the Contractor and shall include port holes in the cover to visually monitor the LED status.
- C. There shall be the following types of modules:
1. Type 1: Monitor Circuit Interface Module:
 - a. For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACP.
 - b. For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.
 2. Type 2: Line Powered Monitor Circuit Interface Module
 - a. This type of module is an individually addressable module that has both its power and its communications supplied by the two wire multiplexing signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACP.
 - b. This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.
 3. Type 3: Single Address Multi-Point Interface Modules
 - a. This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.
 - b. This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.

- c. This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.
- 4. Type 4: Line Powered Control Circuit Interface Module
 - a. This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.
- D. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

2.7 ALARM NOTIFICATION APPLIANCES:

- A. Notification Appliances: The Contractor shall furnish and install Notification Appliances and accessories to operate on compatible signaling line circuits (SLC).
 - 1. Notification appliance operation shall provide power, supervision and separate control of speakers and strobes. The controlling channel (SLC) digitally communicates with each appliance and receives a response to verify the appliance's presence on the channel. The channel provides a digital command to control appliance operation.
 - 2. Class B (Style 4) notification appliances shall be wired without requiring traditional in/out wiring methods; "T" Tapping shall be permitted. Up to 63 appliances can be supported on a single channel.
- B. Visible/Only: Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. V/O appliances shall be provided with different minimum flash intensities of 75cd and 110cd where indicated. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
- C. Audible/Visible: Combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 83 or 89 dBA @ 24VDC. The audible/visible enclosure shall mount

directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings.

1. Audible portion shall be a speaker.

D. Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The Isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The following functionality shall be included in the Isolator module:

1. Report faults to the host FACP.
2. On-board Yellow LED provides module status.
3. After the wiring fault is repaired, the Isolator modules shall test the lines and automatically restore the connection.

E. Accessories: The contractor shall furnish the necessary accessories.

2.8 NAC POWER EXTENDER:

- A. The Controller shall be a stand-alone panel capable of powering a minimum of 3 Signaling line circuits. Each channel shall be rated for 2.5 amps and support up to 63 notification appliances. Power and communication for the notification appliances shall be provided on the same pair of wires.
- B. SLC notification appliance circuits shall be Class B Style 4.
- C. The internal power supply & battery charger shall be capable of charging up 12.7 Ah batteries internally mounted or 18Ah batteries mounted in an external cabinet.
- D. The NAC extender panel may be mounted close to the host control panel or can be remotely located.

2.9 MAGNETIC DOOR HOLDERS:

- A. Magnetic door holders shall be made from high quality die-cast aluminum and finished with a black powder coat finish. Devices shall be robust, attractive, and compact.
- B. Magnetic door holders shall keep fire/smoke doors open and release them in the event of a fire alarm condition.

- C. The door holders shall consist of two parts, the electromagnet and the counter plate. The electromagnet is wall or floor mounted and the counter plate is fitted to the door.
- D. The operating voltage shall be 24VDC and the fire alarm panel door holder power supplies shall be integrated into the fire alarm control panel.
- E. Holding force shall be a minimum of 100kg.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

- A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.
- B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:
 - 1. Factory trained and certified personnel.
 - 2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.
 - 3. Personnel licensed or certified by state or local authority.
- C. The new fire alarm system and all related equipment required is designed and detailed within this specification and will be installed. The Contractor is responsible for any other equipment required which may not be detailed in the drawings or listed within the specification shall be installed for proper installation and operation of the new system. This includes all device backboxes and cover plates where required.

3.2 EQUIPMENT INSTALLATION:

- A. Install a complete Fire Alarm System as described herein and as shown on the plans. Include all other necessary material for a complete operating system.
- B. Duct Smoke Detectors: Comply with manufacturer's written instructions:
 - 1. Verify that each unit is listed for the complete range of air velocity, temperature, and humidity of the existing air handling system.
 - 2. Verify that the fan shutdown relay is rated to interrupt the existing air handling system fan motor control circuit.
 - 3. Install sampling tubes so that they extend the width of the existing duct.

- C. Monitor Modules: Mount within electrical boxes near the sprinkler waterflow, pressure, and/or tamper switches. Coordinate location and interconnection with the sprinkler system. Remove existing steel boxes in Garage areas and provide and install NEMA 12 boxes with a gasket for the monitor module cover.
- D. Control Relays: Mount within existing electrical boxes as recommended by the fire alarm manufacturer.
- E. Manual Pull Stations: Surface mount pull stations in back boxes. Mount new pull stations so that top of pull station is 48" above finished floor, as per ADA standards
- F. Fire Alarm Control Panels: Install so that the top of the cabinet is not more than 72 inches above the finished floor.
- G. Isolation Modules: Where called for on plans install in same location as existing device to be removed.
- H. Remote Annunciators: Install per manufacturer's recommendations. Mount at height so that LCD is viewable.

3.3 WIRING INSTALLATION:

- A. System Wiring: Wire and cable shall be a type listed for intended use by an approval agency acceptable to the Authority Having Jurisdiction and shall be installed in accordance with the appropriate articles from the latest edition of NFPA 70: National Electric Code (NEC).
- B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. The Contractor shall make no deviation from the written instruction without the prior written approval of the Fire Alarm System Manufacturer.
- C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red. Provide and install wire numbers and number terminal strips.

3.4 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pre-testing, final testing, and adjustment of the system.

- B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:
 - 1. Factory trained and certified.
 - 2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
 - 3. International Municipal Signal Association (IMSA) fire alarm certified.
 - 4. Certified by a state or local authority.
 - 5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

- C. Pre-testing: Determine, through pre-testing, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.

- D. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.

- E. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72.

- F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

- G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log.

- H. Final Test, Certificate of Completion, Certificate of Occupancy, and first annual inspections:
 - 1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy.
 - 2. Provide the first annual fire alarm inspection as required by NFPA 72.

3.5 FINAL ADJUSTING:

- A. Occupancy Adjustments: When requested within the one year of date of final acceptance, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to (3) three visits to the site for this purpose.

3.6 TRAINING:

- A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.
 - 1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 4 training sessions each two hours long in duration.
 - 2. Schedule training with the Owner at least seven days in advance.

3.7 WARRANTY:

- A. Warrant that the Products be free from defects in material and workmanship under normal use for a period of one year from the date of final project acceptance of all or any part of the system. Supplier shall warrant that any software supplied under this contract, as well as that software contained in or sold as part of any product supplied, will conform to its published specifications in effect at the time of delivery and for one year after final project acceptance.

END OF SECTION 283101

SECTION 321743 - SNOW MELT HEATING PANELS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes the requirements for furnishing all UL Listed Snow Melt Heating Panels, snow sensors, connection kits and electronic controllers, and all electrical panels necessary for a complete and functional the system.
- B. Related Sections:
 - Section 051300 – Retractable Platform Edge
 - Section 066100 - Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels
- C. Contractor to coordinate with snow melt manufacturer and all other trades involved to deliver a functional system.

1.3 SUBMITTALS

- A. Manufacturer's Data: The Contractor shall submit copies in accordance with SECTION 01330 – SUBMITTAL PROCEDURES of the manufacturer's specifications, data and instructions for the manufactured materials and products.
- B. Shop Drawings: The Manufacturer shall prepare shop drawings for submittal in accordance with SECTION 01330 – SUBMITTAL PROCEDURES.
 - 1. Snow Melt Heating Panels:
 - a. Panel dimensions.

- b. Locations and details of anchorage devices.
- c. Electrical drawings detailing wiring types and layout, heater models and locations, connector types and locations and control and distribution panel components.

C. Manufacturer's Sample Warranty

D. Maintenance Data: Include operation and maintenance manual.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firm experienced in producing Snow Melt Heating Panels similar to those indicated for this project and with a record of successful in-service performance as well as sufficient production capacity to produce required units without delaying the work.

Source Limitations: Obtain products from a single manufacturer. **This is a sole source item and no substitutions will be allowed.**

B. DELIVERY, STORAGE AND HANDLING

- A. Retain panels in factory applied shipping materials until ready for installation.
- B. Retain caps on cable ends and connectors until connection is ready to be made.

1.5 WARRANTY

- A. Guarantee for no less than ten (10) years from the date of installation against manufacturer defects.
Any such panel that fails during the stipulated guarantee period shall be replaced or repaired at no additional cost to the owner.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Source limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01. **This is a sole source item and no substitutions will be allowed.**
- B. Available Manufacturer:

Nexatherm Heating Panel Systems as fabricated by Engineered Plastics, Inc., 300 International Drive, Suite 100, Williamsville, NY 14221, 800-682-2525.

2.2 SNOW MELT HEATING PANEL SYSTEM

- A. Internal replaceable heating panels are to be 480V/277V single or 3 phase.
- B. Heater wattage to be 80W/SF per ASHRAE standards.
- C. Heating panels are to be controlled automatically through external snow, humidity, ambient and panel temperature sensors and remotely through web browser. Capable of cycling through zones to reduce power requirements if required.
- D. Heating panels are to be encased top and bottom in composite panel systems impervious to extreme exterior environments.
- E. Heating panels are to be replaceable in the field by unscrewing the top composite surface and disconnecting the twist lock cable connectors.
- F. All exposed fasteners are to be stainless steel.
- G. Heating panels shall meet the following criteria:
 - 1. Maximum Temperature: 158 °F
 - 2. Minimum Temperature: - 40 °F
 - 3. Dielectric Strength: ≥ 20 kV
 - 4. Insulation Resistance: ≥ 20 M Ω
 - 5. Waterproof Rating: IP67
 - 6. Water Absorption ASTM D570 ≤ 0.8 %
- H. Entire snow melting system to meet all applicable electrical codes.
- I. Connection Kits, junction boxes, caution signs per manufacturer recommendations.
- J. Energy Efficient Controller (Digital Control) and contactors as recommended by Engineer Plastics.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Snow Melt Heating Panels to be factory installed in composite structures such as platform, bridge and ramp panels and stairs.

- B. Comply with manufacturer's recommendations for connection kits, installation and operation manuals.
- C. Grounding of the system shall be done according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Connect Snow Melt Heating Panel cables with twist lock connectors to supplied wiring harnesses as indicated on manufacturer's shop drawings. Connect Snow Melt Heating Panel cables with bare wires into junction boxes as indicated on manufacturer's shop drawings.
- E. Connection of all electrical wiring shall be according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables".

3.2 FIELD QUALITY CONTROL

- A. Initial start-up and field testing (commissioning) of the system shall be performed by factory technician or factory representative per the owner's requirements.
- B. Field Tests And Inspections
 - 1. The system shall be commissioned in accordance to the System Installation and Operation manual.
 - 2. The technician shall verify that the controller parameters are set to the application requirements.
 - 3. All commissioning results will be recorded and presented to the Owner.
- C. Non-Conforming Work
 - 1. Any circuit which fails the any of the above tests must be corrected prior to commissioning or startup of the system.
- D. Manufacturer to provide factory design build and inspection services and prepare submittals for complete design layouts, wiring diagrams, installation details for all equipment including heating panels, connection kits, controllers and sensors. Supply 11"x17" isometric drawings for a complete heat tracing system.
- E. Provide factory inspection report as part of a complete manufacturer approved installation that is compliant to codes.
- F. Start-up – Start-up of system shall be performed by factory technician or factory representative per the owner's requirements.

3.3. SYSTEM STARTUP

- 1. Provide a factory-certified technician or manufacturer's representative for startup and commissioning of the heat tracing system and controller.
- 2. Coordinate all controller settings with engineer prior to programming the controller.
- 3. Provide commissioning report in submittals package to owner.

3.4. MAINTENANCE

A. Maintenance Service

1. Comply with manufacturer's recommendations in System Installation and Operation Manual.

END OF SECTION

SECTION 323119 - DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions of Division 1, State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817 - 2016 and supplemental specifications thereto, shall be a part of this specification.
- B. Work included in this section may require coordination with Amtrak regarding track outages, flagmen, or other issues related to work around railroad facilities. The Contractor shall pay special attention to the specification entitled "SAFETY AND PROTECTION OF RAILROAD TRAFFIC AND PROPERTY" and other Amtrak Specifications contained in the Contract.
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Decorative steel fences.
- B. Related Sections:
 - 1. Section 055000 "Metal Fabrications".
 - 2. Section 066000 "Structural Reinforced Modular Polymer Composite Deck and Surface-Applied Panels" for fastening.
 - 3. Section 067413 "Fiberglass Reinforced Gratings" for fastening.
 - 4. Section 260526 "Grounding and Bonding for Electrical Systems" for grounding of fencing.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Submit the following in accordance with Form 817 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.
- B. Product Data: For each type of product.

- C. Shop Drawings: For gates. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include diagrams for power, signal, and control wiring.
- D. Samples: For each fence material and for each color specified.
 - 1. Provide Samples 12 inches in length for linear materials.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01. **This is a sole source item and no substitutions will be allowed.**
- B. Installer Qualifications: Fabricator of products.
- C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Include 10-foot length of fence complying with requirements.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 WARRANTY

- A. Refer to Form 817, Article 1.20-1.06.08, and the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. All structural fence components (i.e. rails, pickets, and posts) shall be warranted by the manufacturer for a period of twenty-five (25) years against defects in material finish, including cracking, peeling, chipping, blistering or corroding
- C. Repair or replace any panel that fails during the manufacturer's extended warranty period at no additional cost to CTDOT, including labor to remove failed section and install replacement section.
- D. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufacturer's warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.
- B. Structural Performance of Decorative Metal Fencing: Fencing shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Top Rails of Fencing:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Fencing:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.

2.2 DECORATIVE STEEL FENCES

- A. Source Limitations: Obtain products from a single manufacturer in accordance with Form 817 Article 1.20-1.06.01.
- B. Decorative Steel Fences: Fences made from steel tubing bars and shapes, hot-dip galvanized.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Ameristar Fence Products, Inc. (888)333-3422; Montage II Welded Ornamental Steel Fence - 3-Rail -Genesis style. **This is a sole source item and no substitutions will be allowed.**
- C. Posts: Square steel tubing.
 - 1. Line Posts: 2-1/2 by 2-1/2 inches with 12-gauge thickness.
 - 2. End and Corner Posts: 2-1/2 by 2-1/2 inches with 12-gauge thickness.
- D. Post Caps: Formed from steel sheet and hot-dip galvanized after forming.
- E. Rails:
 - 1. Steel Channel Rails: Steel channels 1.75 inches by 1.75 inches x .105 inches with picket holes spaced 4.715 inches on-center.
- F. Pickets: 3/4-inch Decorative steel bars of pattern and size indicated.

1. Extend pickets beyond top rail as indicated and cap with metal spear point finial.
 2. Picket Spacing: 4.675 inches on-center. 4" clear space maximum between.
 3. Square Tubes: 1 inch square x 14 gauge steel tubing.
- G. Fabrication: Assemble fences into sections by welding pickets to rails.
1. Fabricate sections with clips welded to rails for field fastening to posts.
 2. Drill posts and clips for fasteners before finishing to maximum extent possible.
- H. Finish exposed welds to comply with NOMMA Guideline 1, Finish #4 - good-quality, uniform undressed weld with minimal splatter.
- I. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.
1. Hot-dip galvanize posts and rails.
 2. Hot-dip galvanize rail and picket assemblies after fabrication.
 3. Hot-dip galvanize custom-design rail and infill assemblies after fabrication.
- J. Finish for Steel Items High-performance coating.

2.3 STEEL AND IRON

- A. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Bars (Pickets): Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- C. Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
1. Bars: Hot-rolled steel strip, ASTM A 1011/A 1011M, Commercial Steel, Type B.
 2. Wire Rods: ASTM A 510.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 50, with G60 coating.
- E. Castings: Either gray or malleable iron unless otherwise indicated
1. Gray Iron: ASTM A 48/A 48M, Class 30.
 2. Malleable Iron: ASTM A 47/A 47M.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.5 GROUNDING MATERIALS

- A. Grounding Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
 - 1. Material above Finished Grade: Copper.

2.6 STEEL FINISHES

- A. Surface Preparation: Clean surfaces according to SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
 - 1. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.
- B. Powder Coating: Immediately after cleaning, apply two-coat finish consisting of epoxy primer and TGIC polyester topcoat, with a minimum total dry film thickness of not less than 8 mils. Comply with coating manufacturer's written instructions.
 - 1. Color and Gloss: Black, eggshell.
- C. Primer Application: Apply zinc-rich epoxy primer immediately after cleaning, to provide a minimum dry film thickness of 2 mils per applied coat, to surfaces that are exposed after assembly and installation, and to concealed surfaces.
- D. High-Performance Coating: Apply intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
 - 1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DECORATIVE FENCE INSTALLATION

- A. Install fences according to manufacturer's written instructions.
- B. Install fences by setting posts as indicated and fastening rails to posts.
- C. Post Setting: Set posts with mechanical anchors at indicated spacing to wood frame platform substrate and vertical edge of concrete platform.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with mechanical devices.
 - 2. Space posts as indicated on drawings.
 - 3. Fence panels shall be attached to posts with brackets supplied by the manufacturer.
 - 4. Posts setting by plated posts must be shown by engineering analysis to be sufficient in strength for the intended application.

END OF SECTION 323119

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**

No Permits are required for this contract

- **CONSTRUCTION CONTRACTS - REQUIRED CONTRACT PROVISIONS
(STATE FUNDED ONLY CONTRACTS)**

**Construction Contracts - Required Contract Provisions
(State Funded Only Contracts)**

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EXHIBIT D - State Wage Rates and Other Related Information (page 25)

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 31-53a 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 3-112a 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
Female

Minority

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
Southbury
Wolcott

Middlebury
Thomaston
Woodbury

Naugatuck
Waterbury

Prospect
Watertown

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 is 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 ULTIMATELY ARISE CONCERNING 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, fascia, 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
Heavy/Highway Construction**

ID#: 20-12083

**Connecticut Department of Labor
Wage and Workplace Standards Division**

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 to the welfare and pension fund shall pay this amount to each employee as part of his/her hourly wages.

Project Number: #320-0019

Project Town: Windsor

State#: #320-0019

FAP#: #320-0019

Project: Platform for Train Station

CLASSIFICATION	Hourly Rate	Benefits
1) Boilermaker	33.79	34% + 8.96
1a) Bricklayer, Cement Masons, Cement Finishers, Plasterers, Stone Masons	35.72	33.16
2) Carpenters, Piledrivermen	33.53	25.66
2a) Diver Tenders	33.53	25.66
3) Divers	41.99	25.66
03a) Millwrights	34.94	26.19
4) Painters: (Bridge Construction) Brush, Roller, Blasting (Sand, Water, etc.), Spray	51.0	21.80
4a) Painters: Brush and Roller	34.62	21.80
4b) Painters: Spray Only	36.62	21.80
4c) Painters: Steel Only	35.62	21.80
4d) Painters: Blast and Spray	37.62	21.80
4e) Painters: Tanks, Tower and Swing	36.62	21.80

Project: Platform for Train Station

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)	40.0	27.67+3% of gross wage
6) Ironworkers: Ornamental, Reinforcing, Structural, and Precast Concrete Erection	36.67	35.77 + a
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)	43.62	32.06
----LABORERS-----		
8) Group 1: Laborer (Unskilled), Common or General, acetylene burner, concrete specialist	30.75	20.84
9) Group 2: Chain saw operators, fence and guard rail erectors, pneumatic tool operators, powdermen	31.0	20.84
10) Group 3: Pipelayers	31.25	20.84
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	31.25	20.84
12) Group 5: Toxic waste removal (non-mechanical systems)	32.75	20.84
13) Group 6: Blasters	32.5	20.84
Group 7: Asbestos/lead removal, non-mechanical systems (does not include leaded joint pipe)	31.75	20.84
Group 8: Traffic control signalmen	18.0	20.84
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	32.98	20.84 + a
13b) Brakemen, Trackmen	32.01	20.84 + a
----CLEANING, CONCRETE AND CAULKING TUNNEL----		

As of: April 16, 2020

14) Concrete Workers, Form Movers, and Strippers	32.01	20.84 + a
15) Form Erectors	32.34	20.84 + a
----ROCK SHAFT LINING, CONCRETE, LINING OF SAME AND TUNNEL IN FREE AIR:----		
16) Brakemen, Trackmen, Tunnel Laborers, Shaft Laborers	32.01	20.84 + a
17) Laborers Topside, Cage Tenders, Bellman	31.9	20.84 + a
18) Miners	32.98	20.84 + a
----TUNNELS, CAISSON AND CYLINDER WORK IN COMPRESSED AIR: ----		
18a) Blaster	39.47	20.84 + a
19) Brakemen, Trackmen, Groutman, Laborers, Outside Lock Tender, Gauge Tenders	39.27	20.84 + a
20) Change House Attendants, Powder Watchmen, Top on Iron Bolts	37.29	20.84 + a
21) Mucking Machine Operator	40.06	20.84 + a
----TRUCK DRIVERS----(*see note below)		
Two axle trucks	29.51	24.52 + a
Three axle trucks; two axle ready mix	29.62	24.52 + a
Three axle ready mix	29.67	24.52 + a
Four axle trucks, heavy duty trailer (up to 40 tons)	29.72	24.52 + a
Four axle ready-mix	29.77	24.52 + a
Heavy duty trailer (40 tons and over)	29.98	24.52 + a

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Specialized earth moving equipment other than conventional type on-the road trucks and semi-trailer (including Euclids)	29.77	24.52 + a
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----POWER EQUIPMENT 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. & Over, Tunnel Boring Machines. (Trade License Required)	40.97	24.80 + a
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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)	40.64	24.80 + a
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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)	39.88	24.80 + a
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Group 4: Trenching Machines; Lighter Derrick; Concrete Finishing Machine; CMI Machine or Similar; Koehring Loader (Skooper)	39.48	24.80 + a
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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	38.87	24.80 + a
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Group 5 continued: Side Boom; Combination Hoe and Loader; Directional Driller.	38.87	24.80 + a
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Group 6: Front End Loader (3 up to 7 cubic yards); Bulldozer (rough grade dozer).	38.55	24.80 + a
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Group 7: Asphalt Roller; Concrete Saws and Cutters (ride on types); Vermeer Concrete Cutter; Stump Grinder; Scraper; Snooper; Skidder; Milling Machine (24	38.2	24.80 + a
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Group 8: Mechanic, Grease Truck Operator, Hydroblaster, Barrier Mover, Power Stone Spreader; Welder; Work Boat under 26 ft.; Transfer Machine.	37.79	24.80 + a
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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).	37.34	24.80 + a
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Group 10: Vibratory Hammer, Ice Machine, Diesel and Air Hammer, etc.	35.24	24.80 + a
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Group 11: Conveyor, Earth Roller; Power Pavement Breaker (whiphammer), Robot Demolition Equipment.	35.24	24.80 + a
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Group 12: Wellpoint Operator.	35.18	24.80 + a
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Group 13: Compressor Battery Operator.	34.58	24.80 + a
Group 14: Elevator Operator; Tow Motor Operator (Solid Tire No Rough Terrain).	33.41	24.80 + a
Group 15: Generator Operator; Compressor Operator; Pump Operator; Welding Machine Operator; Heater Operator.	32.99	24.80 + a
Group 16: Maintenance Engineer/Oiler	32.32	24.80 + a
Group 17: Portable asphalt plant operator; portable crusher plant operator; portable concrete plant operator.	36.76	24.80 + a
Group 18: Power Safety Boat; Vacuum Truck; Zim Mixer; Sweeper; (minimum for any job requiring CDL license).	34.26	24.80 + 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

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28) Material Men, Tractor Trailer Drivers, Equipment Operators

35.04

6.5% + 10.45

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Welders: Rate for craft to which welding is incidental.

*Note: Hazardous waste removal work receives additional \$1.25 per hour for truck drivers.

**Note: Hazardous waste premium \$3.00 per hour over classified rate

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**
- 3) Cranes (under 100 ton rated capacity)**

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 site ratio shall not be less than one full-time journeyman instructing and supervising the work of each apprentice in a specific trade.

--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.

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~~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.

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