METRO-NORTH COMMUTER RAILROAD COMPANY
SCARSDALE & HARTSDALE STATION IMPROVEMENTS
CONTRACT NO. 100106733

100% FINAL DESIGN
TECHNICAL PROVISIONS

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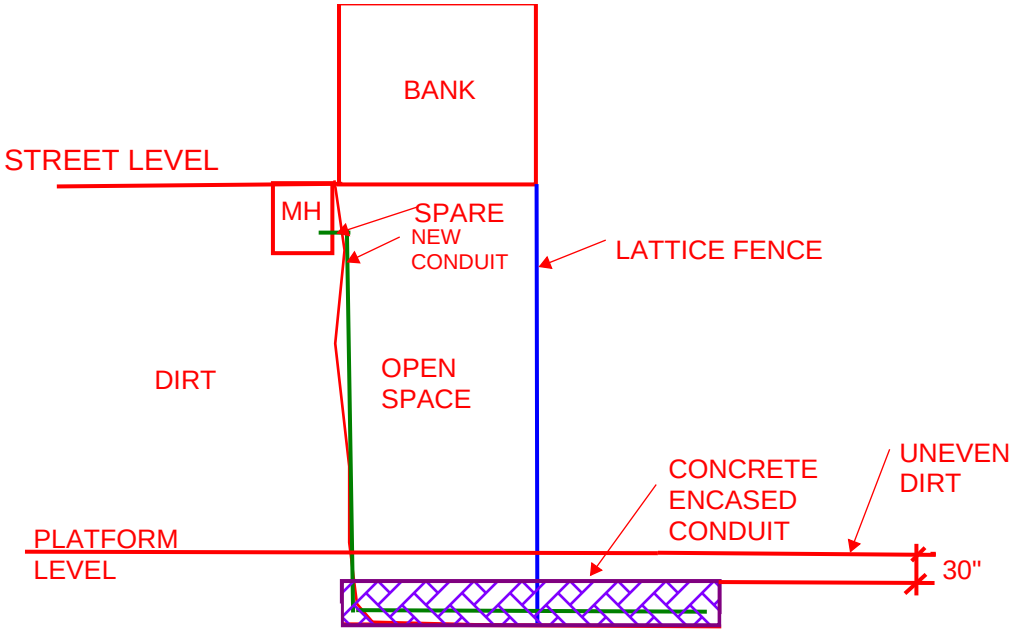
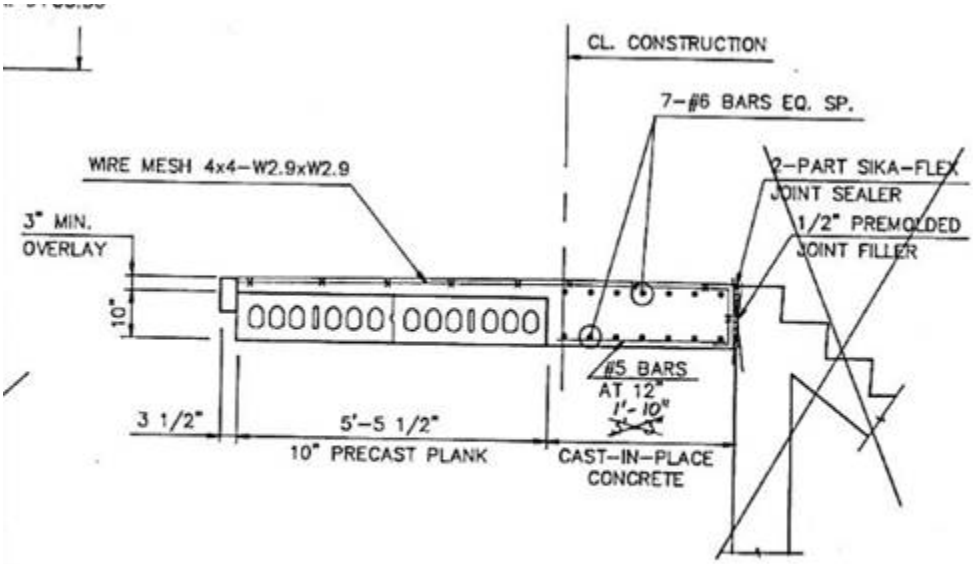
A new property line box shall be provided adjacent to the existing for the new service equipment and existing loads. Transfer all the existing connections. Provide new conduits cable. Remove the existing property line box after completion and testing of all the connections and approval of the Con Edison.



Attachment – Existing Platform Typical Section at Scarsdale Station and Hartsdale Station



SECTION 2–2
SCALE: 1/2" = 1'–0"

NOTES:

1. ALL DIMENSIONS ARE IN FT–IN.
2. FOR DETAILS OF FOOTINGS, HAMMERHEAD PIERS, POSTTENSIONING, PLATFORM & CANOPY PLANKS AND STEEL FRAMES, SEE STRUCTURAL DETAILS.

AS-BUILT

SECTION 05 10 00 - STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies furnishing and constructing steel structures in accordance with the details indicated on the Contract Drawings.

1.2 REFERENCES

A. Reference Standards:
   1. American Institute of Steel Construction (AISC).
      a. AISC Code of Standard Practice for Steel Buildings and Bridges.
      b. AISC Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design.
      c. AISC Specification for Structural Joints Using ASTM A325 Bolts.
   2. American National Standards Institute:
      a. ANSI B18.2.1, Square and Hex Bolts and Screws - Inch Series.
      b. ANSI/ASME B18.2.2, Square and Hex Nuts - Inch Series.
      c. ANSI B18.22.1, Plain Washers.
   3. Federal Specifications (FS):
      a. FF-S-325, Shield, Expansion; Nail Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry).
      b. FF-W-84A, Washers, Lock (Spring).
      c. FF-W-92B, Washer, Flat (Plain).
   4. American Society for Testing and Materials (ASTM):
      a. A6, Specification for General Requirements for Rolled Steel Bars, Plates, Shapes, and Sheet Piling.
      b. A36, Specification for Carbon Structural Steel.
      c. A123, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      d. A153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      e. A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
      f. A320, Specification for Alloy Steel Bolting Materials for Low-Temperature Service.
      g. A325, Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
      h. F436, Specification for Hardened Steel Washers.
      i. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
      j. A992, Standard Specification for Structural Steel Shapes
      k. E164, Ultrasonic Contract Examination of Weldment
      l. E709, Practice for Magnetic Particle Examination
   5. American Welding Society (AWS): ANSI/AWS D1.1 Structural Welding Code (2000).

1.3 SUBMITTALS

A. Submit the following:
   1. Shop Drawings:
      a. Show all shop and erection details including welding technique and sequence, cuts, copes, gussets and all other members, connections, holes, fasteners, camber, fabrication and erection tolerances, type of paint system or other coating, weights of members, length of member, length of span, elevations and critical clearances. Indicate all surface finishes and welds, both shop and field, by symbols conforming to ANSI/AWS Standards. Shop drawings and connection design calculations shall be sealed by a Professional Engineer licensed in New York.
   2. Furnish setting diagrams, for the installation of structural framing anchor bolts, bearing plates, and other embedded items.
   3. Welding Records and Data:
      a. Prior to commencing any work requiring welding, submit the procedure that will be used for prequalifying welders and welding procedures. For all procedures other than those set forth in paragraph 5.1 of ANSI/AWS D1.1 submit a copy of procedure qualification test records.
      b. Submit certified copy of qualification test record for each welder, welding operator, and tacker who will be employed in the work.
      c. Submit data reports of the results of nondestructive inspection tests of shop welds to the Engineer.
         1) Indicate the type and location of shop welds tested, type and location of defects noted, measures taken to correct the defects, and the test results of corrected welds.
         2) Report any defective welds that are not corrected.
   4. Certified copy of reports for all analyses and tests required by referenced ASTM Specifications, including test reports for filler metals for welding, and mechanical tests for high strength threaded fasteners and shear connectors.
   5. Product data, including laboratory test reports and other data required to demonstrate conformance to specified requirements for:
      a. Structural steel, including certified copies of mill reports covering chemical and physical properties.
      b. Anchor bolts and nuts.

1.4 QUALITY CONTROL

A. Qualifications:
   1. Fabricator: Company experienced in fabricating structural steel similar to that indicated for the project who has a successful in-service performance for a minimum of 5 continuous years and sufficient production capacity.
      a. Fabricator must participate in the AISC Quality Certification Program and designated an AISC Certified Plant with conventional steel building structure or building standard.

B. Erector: Company experienced in erecting structural steel work similar to that indicated for the project who has a successful in-service performance with a minimum of 5 continuous years of experience.

C. Welder, Tacker and Welding Operator Qualifications: Use welders, tackers and welding operators who have been previously qualified by tests as prescribed in the Structural Welding

Code, AWS D1.1 of the American Welding Society, to perform type of work required. Welders and inspectors shall be currently certified by AWS.

D. Comply with applicable provisions listed in those references stated in Article 1.02 of this specification unless otherwise indicated.

E. Materials and fabrication procedures are subject to inspection and tests in mill, shop and field by a qualified inspection agency. Such inspections and tests will not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

F. Promptly remove and replace materials or fabricated components that do not comply.
   1. All AESS fabrications shall be inspected in the shop prior to the shipment of those materials to the field.

1.5 DELIVERY, HANDLING AND STORAGE

A. Exercise care to avoid bending, scraping, and overstressing the steelwork. Block with wood, or otherwise protect, projecting parts likely to be bent or injured.

B. For members with gross shipping weight greater than 5 ton, mark weight on member. Match-mark all shop pre-fitted members.

C. Ship small parts, such as bolts, nuts, washers, direct tension indicators, pins, fills, and small connecting plates and anchors, in boxes, crates, or barrels. Pack separately each length and diameter of bolt and each size of nut and washer. Plainly mark in itemized list and description of the contents on the outside of each container.

D. Load, transport, unload, and store structural material in such a manner that the metal is kept clean and free from injury. Store material above ground on platforms, skids, or other supports, and cover and protect it from corrosion.

E. Identify all materials by heat and lot, if applicable.

F. Replace pieces bent or damaged unless repairs are authorized by the Engineer.

G. Ensure uninterrupted delivery of material for continuous progress of the Work.

1.6 COORDINATION

A. Prior to shop painting, coordinate with fire-proofing products manufacturer to verify if steel members indicated to be fireproofed, should also be prime painted, and notify the steel fabricator.

PART 2 - PRODUCTS

2.1 PLATES, SHAPES, AND BARS

A. High Strength Steel: ASTM A572, Grade 50 or ASTM A992, Grade 50, shall be used for all steel shapes.

B. Structural Pipe: ASTM A53.

C. Structural tubing: ASTM A500 Grade B.

D. Structural plates: ASTM A36.

E. All exterior steel exposed to the environment, except steel to receive fireproofing, shall be galvanized, primed, and painted as per specification section 09 90 10 Painting. Galvanization to conform to ASTM A123 and have a thickness equivalent to two (2) ounces per square foot minimum. All interior steel not exposed to the environment, except steel to receive fireproofing, shall be finished in accordance with specification section 09 90 10 Painting.

2.2 SHEAR CONNECTORS

A. Headed Stud Type Shear Connectors: Cold finished carbon steel units conforming to ASTM A108. Provide Shear Connectors by Nelson Studs Welding Systems, or approved equal.

2.3 FASTENERS

A. General:
1. Provide fasteners of type, grade, and class required for the particular use.
2. Square and hex bolts and nuts shall conform to applicable dimensional requirements of ANSI B18.2.1 for bolts and ANSI/ASME B18.2.2 for nuts.

B. Bolts:
1. Standard Steel Bolts: ASTM A325, with ¾" diameter, unless noted otherwise.
2. Carbon Steel Nuts: ASTM A563, Grade A.
3. Washers:
   a. Plain Washers: Round, carbon steel, FS FF-W-92 or ANSI B18.22.1.
   b. Lock Washers: Helical spring type, carbon steel, FS FF-W-84.
   c. Beveled Washers: ASTM F436.
4. Stainless Steel Bolts, Nuts and Washers: ASTM A320, Grade B8, AISC Type 304.
5. Carbon and Alloy Steel Nuts: ASTM A563.
6. Hardened Steel Washers: ASTM F436.

C. Adhesive Anchors: Composed of an anchor rod assembly and an anchor rod adhesive cartridge:
1. Anchor Rod Assembly: Chamfered end threaded stud rod, with nut and washer.
2. Adhesive Cartridge: Sealed capsule containing pre-measured amounts of resin, quartz and aggregate, and a hardener contained in a separate vial within the capsule. Capsule ingredients activated by the insertion procedure of the anchor rod assembly.

D. Masonry Anchorage Devices (Expansion Anchors): FS FF-S-325, Group II, Type 4, Class 1 (stainless steel where specifically called for on Contract Drawings); embed 4 1/2 bolt diameters minimum or as indicated on the Contract Drawings.

E. Anchor Bolts: ASTM A36, or ASTM F1554

F. Expansion Fasteners: Where called for on plans or where otherwise used shall be manufactured by Lindapter North America, Inc or approved equal. Fastener shall be rated for a minimum safe working load of 8,500 pound tensile force and 10,000 pound shear force with a 5 to 1 factor of safety. Submit catalog data of fasteners to be used.

2.4 GROUT AND DRY-PACK MATERIAL

A. Non-shrink, Non-Metallic Grout: As specified in Section 03 60 00.

2.5 PROTECTIVE COATINGS

A. Coating for Interior Steel:
   1. Primer: Rust inhibiting, made for priming under alkyd enamel, VOC compliant.

B. Coating for all other steel - See Section 09 90 00.

2.6 ELECTRODES

A. Use low-hydrogen electrodes for field welding.

B. Electrodes for Structural Plate, Shapes, Pipe, Tubes, and Bars: Conform with ANSI/AWS A5 Series Standards and be coated rods or wire of size and classification number as recommended by their manufacturers for the positions and other conditions of actual use. Matching filler metal requirements shall conform to ANSI/AWS D1.1, Table 3.1., E70XX.

C. Electrodes for Sheet Steel: Conform to Article 2.06.A. above except matching filler metal shall conform to ANSI/AWS D1.3, Table 5.1.

PART 3 - EXECUTION

3.1 FABRICATION

A. General: Fabricate and shop-assemble work in accordance with AISC Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design; AISC Specification for Structural Joints Using ASTM A325 S.C. ; AISC Code of Standard Practice for Steel Buildings and Bridges; and AISC Manual of Steel Construction - Allowable Stress Design.

B. Straighten rolled material, if necessary, before it is laid out for fabrication, in a manner conforming to the mill tolerances provided in ASTM A6/A6M, and by a process and in a manner which will not injure the material. Sharp kinks and bends will be cause for rejection of the material. Straighten, plane, and otherwise correct portions of members in bearing assemblies and in direct bearing after those members have been fabricated.

C. Perform shearing, flame cutting, and chipping carefully and accurately so as not to induce residual stress in the metal being cut. The radii of re-entrant gas-cut fillets shall be not less than (3/4 inch) and as much larger as practicable. Perform flame cuttings in such manner that metal being cut is not carrying stress. Exposed edges, flame-cut by hand, shall be finished by grinding.

D. Fabricate bearing stiffeners and stiffeners intended as supports for concentrated loads to have full bearing on the flanges. Mill or grind bearing surfaces of these stiffeners. Such stiffeners may be welded as indicated on the Contract Drawings.

E. The radius of bend, measured to the concave face of the metal, shall conform to AISC Manual of Steel Construction, Part 4.

F. Planning and Facing:
1. Fabricate floor beams, stringers and girders having end connection angles to exact length back to back of connection angles.

G. Connections:
1. Except where welded or ASTM A307 bolted connections are shown, use ASTM A325 bolts for all shop and field connections.
2. Bolt field connections in bearing-type connections using ASTM A325 bolts, nuts and hardened washers in accordance with AISC specifications.
3. Bolt field connections in slip-critical connections using ASTM A325 bolts, nuts and direct tension indicators, or tension control bolts.

H. Bolt Holes: Punch, drill, subpunch, subdrill and ream holes for bolts as required in accordance with AISC Specifications.

I. Welding: Perform all welding in accordance with ANSI/AWS D1.1

J. Bolting:
1. For connections using high-strength steel bolts, conform to requirements of AISC Specifications.
2. Assemble high-strength bolted parts so that they fit solidly together when assembled. Do not use gaskets or any other interposed compressible materials.
3. Remove scale, dirt, butts and other defects liable to prevent proper seating when assembling joint surfaces, including those adjacent to washers.
4. Clean off oil, paint or lacquer from contact surfaces of friction-type joints.
5. For bearing-type connections, tighten the A325 bolts to a snug tight condition achieved by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench to the extent that all plies of the connected material have been brought into snug contact.
6. For slip-critical type connections, tighten the A325 bolts as specified in the AISC Specification for Structural Joints Using A325, 1985, Subsection 8 (d) (1).
7. Arrange bolts so that heads show in areas exposed to view.

K. Shop Painting:
1. Surface Preparation: Hand Tool Cleaning – SSPC-SP2, or Power Tool Cleaning - SSPC-SP 3, per manufacturer’s recommendation.
2. Apply one shop coat of primer paint to structural steel in accordance with manufacturer's recommended procedures at mil thickness specified in Section 09900.
3. Apply only a primer coat onto faying surfaces, for bearing – type connections

3.2 ERECTION

A. Erect steel members true and plumb following the match marks and in accordance with the Drawings, pertinent regulations and referenced AISC standards.
1. Allow concrete foundations to reach a minimum of 14-days curing time and 90% of specified design strength before erecting steel and torqueing anchor bolts.

B. Report immediately to the Engineer, errors in shop fabrication or deformation resulting from handling or transportation that prevent the proper erection and fitting of parts.

C. Thoroughly clean surfaces to be joined.

D. Install anchor bolts accurately in position shown.
   1. If anchor bolts are cast in substructure when it is being constructed, ensure that they are firmly held in their correct position and elevation by suitable templates.
   2. If approval is given, by the Engineer, for installing anchor bolts in preformed holes or in drilled holes in concrete or masonry, use approved epoxy adhesion anchor system for securing them in place.

E. Align column bases and bearing plates for beams and similar structural members with steel wedges, shims or leveling washer and nut. After the supported members have been aligned and properly positioned and the anchor nuts have been tightened, dry-pack the entire area under bearing plates with grout.

F. Use temporary bracing to resist loads to which the structures may be subjected including erection equipment or the operations of same. Leave bracing in place as long as may be required for safety, and until the wind-force resisting system (shear walls or frames) is constructed.

G. Field Assembly:
   1. Splice only where indicated.
   2. Align and adjust members forming parts of a complete assembly after assembly and before fastening.
   3. Fasten splices of compression members after the abutting surfaces have been brought completely into contact.

H. As erection progresses, perform sufficient bolting of the work to support dead load, and wind and erection loads. Perform permanent bolting when enough alignment has been done to ensure as much of the structure as possible will be supported by such fastening work.
   1. Ensure that holes are not enlarged and that the metal in the vicinity of the holes is not disturbed by the drifting occurring during assembly.
   2. Enlarge holes to admit bolts for connections only if approved by the Engineer. Make the enlargement by reaming and not by burning. Avoid hand reaming.
   3. Erection bolts used in welded construction shall be tightened securely and left in place.

I. Do not weld main stress members in the field except as indicated on the Contract Drawings.

J. Adhesive Anchor Installation:
   1. Install adhesive anchors in strict accordance with manufacturer's instructions.
   2. Following cartridge installation in prepared drill holes, set anchor rod to the required depth. Set anchor rods truly perpendicular (normal) to the base plate of item being anchored.
   3. Minimum Embedment Table (Concrete):

Diameter (in)	3/8	½	5/8	¾	7/8	1
Embedment Depth (in)	3-1/2	4-1/4	5	6-5/8	6-5/8	8-1/4

3.3 QUALITY ASSURANCE TESTING

A. Provide an independent Quality Assurance Testing and Inspection Agency approved by the Engineer to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.

B. The Quality Assurance Testing Agency shall conduct and interpret tests, state in each report whether test specimens comply with requirements, and specifically state any deviations there from.

C. Provide access for the Quality Assurance Testing Agency to places where structural steel work is being fabricated or produced so required inspection and testing can be accomplished.

D. The Quality Assurance Testing Agency may inspect structural steel at plant before shipment.
1. Shop-Bolted Connections: The Quality Assurance Testing Agency will inspect or test in accordance with AISC specifications, and the RCSC's "Specification for Structural Joints Using ASTM A 325 Bolts." Verify proper fastening components were used and the connected elements were fabricated properly.
2. Slip-critical and pretension connections: Test 2 bolts per connection.
3. Shop Welding: The Quality Assurance Testing Agency will inspect and test during fabrication of structural steel assemblies, as follows:
    a. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
    b. Perform visual inspection of full length of all welds. In addition to visual inspection of shop-welded connections, welds will be inspected and tested according to AWS D1.1 and the inspection procedures listed below:
        1) Complete penetration welds: Ultrasonic Inspection; ASTM E 164.
        2) Fillet welds: Magnetic Particle Method; ASTM E709. Perform ultrasonic testing of the entire length of full penetration welds for the following:
        3) Rigid (moment) frame flange connection plates on columns; test fifty (50%) percent of tension plates and twenty (20%) of compression plates.
        4) 10% of all other groove and full-penetration welds.
        5) Perform magnetic particle testing on the entire length of fillet welds as follows: Gusset Plate for bracing to Steel Member: 20% of fillet weld locations. Other locations: 5% of fillet welds.
    c. Field-Bolted Connections: The Quality Assurance Testing Agency will inspect and test field-bolted connections in accordance with AISC specifications and RCSC's "Specification for Structural Joints Using ASTM A 325 Bolts" and the following: Verify proper fastening components were used and the connected elements were fabricated properly.
    d. Slip-critical and pretension connections: Test 2 bolts per connection.
4. Field Welding: The Quality Assurance Testing Agency will inspect and test during erection of structural steel as follows:

    Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
        1) Perform visual inspection of full length of all welds. In addition to visual inspection of shop-welded connections, welds will be inspected and tested according to AWS D1.1 and the inspection procedures listed below:
        2) Complete penetration welds: Ultrasonic Inspection; ASTM E 164.
        3) Fillet welds: Magnetic Particle Method; ASTM. Perform ultrasonic testing of the entire length of complete penetration welds for the following:

4) Rigid (moment) frame flange connection plates on columns; test all welds.
5) 20% of all other groove and full-penetration welds.
6) Perform magnetic particle testing on the entire length of fillet welds as follows:
   a) Beam connection plate (angles) to embedded plate in concrete: test all welds.
   b) Diagonal bracing member to gusset: 40% of fillet weld locations.
   c) Gusset plate for bracing to steel member: 40% of fillet weld locations.
   d) 10% of all other fillet welds

5. Welding of rigid frame flange connection plates on columns shall be done in the field only if required for ease of erection. This field welding, if required, shall be clearly indicated on the shop drawings.

E. The Quality Assurance Testing Agency will confirm that the structure is square, plumb, and level in accordance with AISC and AESS tolerances.

1. Remove and replace work that does not comply with specified requirements.
   a. The Prime Contractor shall correct deficiencies in structural steel work that inspections
   b. and test reports have indicated to be not in compliance with requirements. The Quality
   c. Assurance Testing Agency will perform additional tests, at the Prime Contractor's
   d. expense, as necessary to reconfirm any noncompliance of original work and to show
   e. compliance of corrected work.

3.4 FIELD TOUCH-UP PAINTING

A. General: Paint bolt heads and nuts, field welds and areas within 2 inches of welds and touch up abrasions in the shop coat.

B. Surface Preparation: Use methods at least as effective as those specified for the structure itself but in no case less than SSPC-SP 3 for removal of handling marks and SSPC-SP 6 for areas showing rust.

C. Paint: Use those individual products as specified for Shop Paint.

END OF SECTION

SECTION 10 81 13
BIRD CONTROL DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Installation of control strips, netting, and netting accessories to prevent birds from landing on surfaces as specified herein and on the contract drawings. Refer to Bird Control detail included at the end of this Specification.

1.02 RELATED SECTIONS

A. Section 05 10 00 - Structural Metal Framing

B. Section 05 50 00 - Metal Fabrication

1.03 SUBMITTALS

A. The Contractor shall submit the following information in accordance with the General Provisions:

B. Product Data:
   1. Provide Manufacturers' product literature for materials specified and material Manufacturer's printed directions and recommendations for installation.

C. Samples:
   1. Initial Selection: Submit Manufacturer's custom color for each matching surfaces for approval by the Engineer.
   2. Verification prior to installation.
      a. When required by Engineer, submit sample of each item fastened on a 12" x 12" hardboard.

D. All samples shall be labeled; and include the following information:
   a. Manufacturer's name.
   b. Model Type.
   c. Manufacturer's stock number.
   d. Color for strips: name and number (powder coat custom colors to match the installation surfaces).
   e. Color for netting: refer to Architectural Drawing Finish Schedule
   f. Instructions for installation.

E. All submittals shall comply with the requirements of the General Provisions.

1.04 QUALITY ASSURANCE

A. General**:** Refer to Division 1 Quality assurance

B. Reference standards:
   1. General**:** Refer to Division 1 Reference standards.

C. Obtain all installation information from Manufacturer.

D. Use workers completely familiar with bird control installations.

E. Installer Qualifications: Installer of bird deterrent system is a certified installer with documented history installing manufacturer's products according to manufacturer's specifications.

F. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

1. Protect control strips, netting, and netting accessories from damage before and during installation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Manufacturers:
   1. NIXALITE of America Inc., 1025 16th Avenue, East Moline, IL 61244-1424, Ph: 888-624-1189
   2. Bird-B-Gone, 23918 Skyline, Mission Viejo, California, 92692, Ph: 800-392-6915
   3. Engineer's approved equal.

B. Products:
   1. Model: Pigeon Spike – stainless steel
      a. Basis of design: Nixalite E-Spike
   2. Model: Bird Netting – ½" Polyethylene netting
      a. Basis of design: Nixalite Bird-net

C. Mounting systems
   1. Stainless steel fasteners and hardware as specified by the Manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine work area; note any detrimental conditions that would interfere with proper installation of the bird control.

B. Do not proceed until conditions are corrected.

C. By beginning installation of bird control, contractor is indicating his acceptance of the condition of the work area.

3.02 SURFACE PREPARATION

A. Clean Surface thoroughly before beginning installation. In all installations, the area must be prepared - with the removal of any and all bird droppings, debris, dirt and other foreign matter and the area must be clean of grease, salt and film, loose (flaking) paint, etc.

3.03 INSTALLATION

A. Install in accordance with Manufacturers installation instructions.

B. Strip:
   1. Strip must cover the entire depth of surface, not just perimeter. Cut strips to follow all angles and contours closely.
   2. Strips must be tangent to the surface, uniform in appearance and have no end-to-end gaps. Refer to the surface Depth charts and specifications in Manufacturer brochures.
   3. Where more than one row is needed, the direction of the rows must alternate and clusters of barbs are to be staggered for maximum effectiveness.
   4. It is extremely important for strip prongs to be pointed in an "upward" direction. Before installation - holding the product to the installation surface - pre-shape the base strip so it fits the installation surface exactly as you want it to. Then pre-shape the prongs to point in an upward direction. After you are completely satisfied that strip is shaped properly, make the installation.

C. Netting:
   1. Features and Components:
      a. 4’ zipper at all Light Fixtures and 2’ zipper at all Equipment.
      b. See architectural drawings for zipper layout.
      c. All clip, turnbuckles and other Hardware to be furnished by manufacturer.

3.04 INSPECTION

A. Visually inspect bird control strips and bird netting for debris. Inspect mounting systems and netting zippers.

PART 4 - COMPENSATION

4.01 **MEASUREMENT**

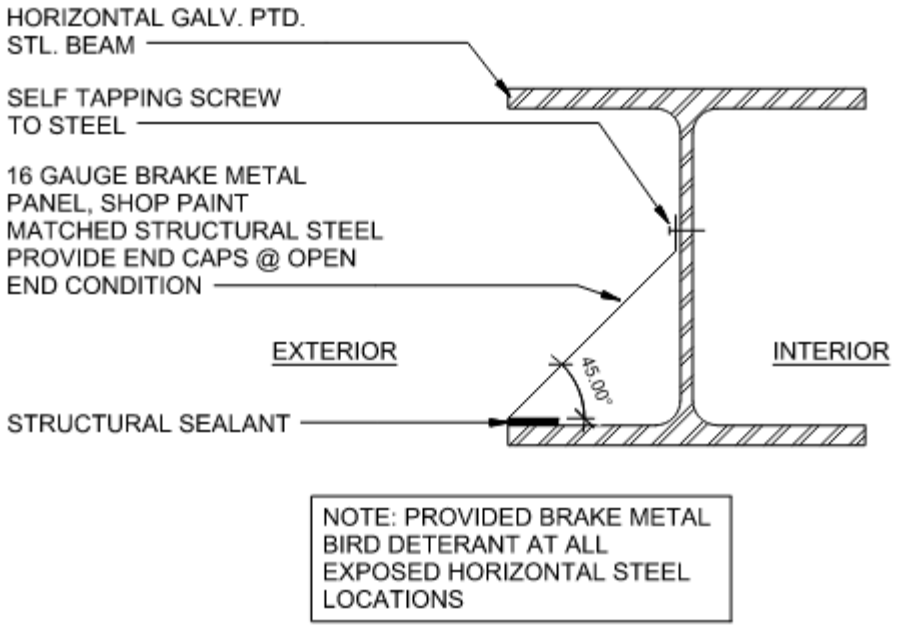
A. The work of this Section will not be measured.

4.02 **PAYMENT**

A. Payment for the work of this Section will be included in the lump sum price bid for the item BIRD CONTROL MATERIAL, which price shall include all work as shown on the Contract Drawings; and shall be full compensation for all labor, materials, tools and equipment, and all else necessary therefor and incidental thereto.

PART 5 - **Detail**

5.01 See below for typical detail.



TYPICAL BIRD DETERANT DETAIL

END OF SECTION

SECTION 14 24 00

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SECTION 14 24 00
HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Hydraulic elevators as follows:
   1. Two passenger elevators, Cars located at the Hartsdale Station (E1 and W1).

B. Related Requirements:
   1. Division 01 Section – General Requirements
   2. Division 03 Section – Concrete
   3. Division 04 Section – Masonry
   4. Division 05 Section – Metals
   5. Division 06 Section – Wood, Plastics and Composites
   6. Division 09 Section – Finishes
   7. Division 22 Section – Plumbing
   8. Division 23 Section – Heating, Ventilating and Air Conditioning (HVAC)
   9. Division 26 Section – Electrical
   10. Division 27 Section – Communications
   11. Division 28 Section – Fire Alarm Systems

1.2 ALLOWANCE

A. Elevator Car Allowances: Provide finished passenger elevator cars under the elevator car allowance which includes furnishing and installing the following:
   1. Car wall finishes including trim.
   2. Car ceiling finishes including lighting, wring, and coordination of battery-operated emergency lighting.
   3. Car door finishes.
   4. Car light fixtures.
   5. Handrails.
   6. Cutouts and other provisions for installing elevator signal equipment in cars.
   7. Mounting for protective pads

1.3 DEFINITIONS

A. Terms used are defined in the latest edition of the Safety Code for Elevators and Escalators, ASME A17.1.

1.4 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44 (2013)

B. Accessibility Requirements: Comply with 2010 ADA standards for Accessible Design and with ICC A117.1. Comply with Uniform Federal Accessibility Standard, UFAS.
   1. The term “withstand” means the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event.
   2. Project Seismic Design Category: B.

3. Elevator Component Importance Factor (Ip): 1.0
4. Design Spectral Response Acceleration (SDS): 0.289

1.5 SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems. Include product data for signal fixtures, lights, graphics, Braille plates, and details of mounting provisions.

B. Shop Drawings:
1. Include plans, elevations, sections, and large-scale details indicating openings at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
2. Include large-scale layout of car operating panel.
3. Indicate maximum dynamic and static loads imposed on building structure at points of support and maximum and average power demands.
4. Power Confirmation Information: Include motor horsepower, code letter, starting current, full - load running current, and demand factor. Provide engineered power consumption estimates based on 120 starts per hour.

C. Samples for Initial Selection: For finishes involving surface treatment, paint or color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes:
1. Samples of sheet materials: 3" (75 mm) square.
2. Running trim members: 4" (100 mm) lengths.

E. Operation and Maintenance Data:
1. For elevators to include in emergency, operation, and maintenance manuals.
2. In addition to items specified in Division 01 Section “General Requirements” include diagnostic and repair information available to manufacturer’s and Installer’s maintenance personnel.

F. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

G. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard two-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.6 QUALITY ASSURANCE

A. Compliance with Regulatory Agencies: Comply with most stringent applicable provisions of following codes, laws, and/or authorities, including revisions and changes in effect:
1. New York State Building Code (IBC 2015) w/2017 Supplements
2. Safety Code for Elevators and Escalators, ASME A17.1 (2013)
3. Guide for Inspection of Elevators, Escalators, and Moving Walks, ASME A17.2
4. Elevator and Escalator Electrical Equipment, ASME A17.5

5. National Electrical Code, NFPA 70 (2017)
6. New York State - American with Disabilities Act (2010)
7. New York State Fire Code (2018) [IFC 2015]
8. Requirements of most stringent provision of local authority having jurisdiction.
9. Life Safety Code, NFPA101

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver material in Contractor's original unopened protective packaging.

B. Store material in original protective packaging. Prevent soiling, physical damage, or moisture damage.

C. Protect equipment and exposed finishes from damage and stains during transportation and construction.

1.8 WARRANTY

1. Manufacturer's Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
2. Failures include, but are not limited to: operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
3. Warranty Period: One year from date of Substantial Completion. The Warranty Period should conclude with a 30 day trouble free period. If any elevator outages or unscheduled repairs are performed during this period, not including those due to vandalism of force majeure, then the Warranty period is extended for an additional 30 days.

1.9 MAINTENANCE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
1. Perform maintenance during normal working hours.
2. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of 60 minutes or less.

The Maintenance Period should conclude with a 30 day trouble free period. If any elevator outages or unscheduled repairs are performed during this period, not including those due to vandalism of force majeure, then the Maintenance period is extended for an additional 30 days.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide borehole hydraulic passenger elevators or comparable product by one of the following:

1. Berringer Elevator Co.
2. Canton Elevator Inc.
3. Elevator Equipment Corporation
4. Elevator Systems (ESI) – Elevator Controller
5. Galaxy – Elevator Controller
6. Leistritz Elevator Corp.
7. Minnesota Elevator, Inc.
8. Monitor Elevator Products
9. Otis Elevator Company
10. Schindler Elevator Corporation
11. Thyssenkrupp Elevator

2.2 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Passenger Elevators Description:
Elevator Identification: Cars E1 & W1

1. Capacity: 4,000 lbs.
2. Class of Loading: Class A
3. Contract Speed: 125 fpm
4. Machine: Submersible Hydraulic pump
5. Machine Location: Adjacent
6. Operational Control: Single automatic, Collective Microprocessor-Based System
7. Motor Control: Single speed AC with SCR soft start with closed transition
8. Power Characteristics: 208 Volts, 3 Phase, 60 Hertz
9. Stops and Openings: E1: 3/3 – 1 Front; 2 Side; W1: 3/3 - 1 Front, 2 Rear
10. Floors Served: Street Level, Platform Level, Overpass Level
11. Travel: E1 & W1: 15'-2" ±
12. Platform Size: E1: 7'-0" wide x 7'-4 1/2" deep Cornerpost; W1: 7'-10" wide X 7'-4" deep
13. Minimum Clear Inside Car: E1: 6'-0" wide x 6'-4 1/2" deep; W1: 7'-0" wide x 6'-0" deep;
14. Entrance Size: 4'-0" wide X 7'-0" high
15. Entrance Type: E1: Two-speed, side-opening; W1: Single-speed, center-opening
16. Door Operation: High-speed, heavy-duty door operator. Minimum Opening Speed: 2½ fps
17. Door Protection: Three-dimensional infrared, full screen device, with differential timing, nudging, and interrupted beam time
18. Hydraulic Type: Direct plunger
19. Guide Rails: Planed Steel Tees
20. Buffers: Spring
21. Car Enclosure:
    a. stationary returns
    b. Stainless Steel and Glass enclosure and Car interior finishes provided under this section. Clear height under canopy, Car 8': 0"

c. Car interior ventilation.
d. Pad buttons or hooks and vinyl-covered pads.

22. Signal Fixtures: LED illumination. NEMA 4 and NEMA 12 design for weather resistance, vandal resistant buttons and fixtures.
    a. Hall and Car Pushbutton Stations:
        1) Single hall pushbutton riser
        2) Dual car operating panels
        3) NEMA-4, NEMA-12, Vandal resistant car and hall pushbuttons
    b. Car Position Indicators:
        1) Digital in car station with car direction arrows
    c. Car Direction Lanterns: All car entrance columns with volume adjustable electronic chime or tone, vandal-resistant assembly.
23. Communication System:
    a. Intercom with Distress Signal

    b. Self-Dialing, Vandal Resistant, Push to Call, Two-Way Communication System with Recall, Tracking, and Voiceless Communication
24. Additional Features:
    a. Hoistway access switches, top and bottom floors
    b. Hoistway door unlocking device, all floors
    c. Anti-nuisance feature
    d. CCTV provisions, all cars
    e. Firefighters' control panel, remote conduit, and wiring
    f. Sill support angles
    g. Firefighters' telephone jack
    h. Liftnet Remote Monitoring System
    i. Provide pit access ladder(s)
    j. System diagnostic means and instructions
    k. Platform Isolation, Jack to Platen Connections
    l. Hydraulic Pump Unit with Oil Tank, UV5A Control Valve Unit, or approved equal, and Controller Sound Isolation
    m. Jack Hole, Outer Casing, and Watertight PVC Inner Casing with Secondary Containment Provisions

2.3 MATERIALS

A. Steel:
1. Sheet Steel (Furniture Steel for Exposed Work): Stretcher-leveled, cold-rolled, commercial quality carbon steel, complying with ASTM A366, matte finish.
2. Sheet Steel (for Unexposed Work): Hot-rolled, commercial quality carbon steel, pickled and oiled, complying with ASTM A568/A568M-03.
3. Structural Steel Shapes and Plates: ASTM A36.

B. Stainless Steel: Type 316 complying with ASTM A240, with standard tempers and hardness required for fabrication, strength, and durability. Apply mechanical finish on fabricated work in the locations shown or specified, Federal Standard and NAAMM nomenclature, with texture and reflectivity required to match Architect's sample. Protect with adhesive paper covering.
1. No. 4 Satin: Directional polish finish. Graining directions as shown or, if not shown, in longest dimension.

2. Textured: Provide 5WL as manufactured by Rigidized Metals or Windsor pattern as manufactured by Rimex Metals or approved equal with .050 inches mean pattern depth with bright directional polish (No. 4 satin finish).
3. Burnished: Non-directional, random abrasion pattern.

C. Aluminum: Extrusions per ASTM B221; sheet and plate per ASTM B209.

D. Plastic Laminate: ASTM E84 Class A and NEMA LD3.1, Fire-Rated Grade (GP-50), Type 7, 0.050" ±.005" thick, color and texture as follows:
1. Exposed Surfaces: Color and texture selected by Architect.
2. Concealed Surfaces: Contractor's standard color and finish.

E. Fire-Retardant Treated Particle Board Panels: Minimum 3/4" thick backup for natural finished wood and plastic laminate veneered panels, edged and faced as shown, provided with suitable anti-warp backing; meet ASTM E84 Class "I" rating with a flame-spread rating of 25 or less, registered with Local Authorities for elevator finish materials.

F. Natural Finish Wood Veneer: Standard thickness, 1/40" thoroughly dried conforming to ASME/HPMA HP-1983, Premium Grade. Place veneer, tapeless spliced with grain running in direction shown, belt, and polish sanded, book-matched. Species and finish designated and approved by Architect.

G. Paint: Clean exposed metal parts and assemblies of oil, grease, scale, and other foreign matter and factory paint one shop coat of standard rust-resistant primer. After erection, provide one finish coat of industrial enamel paint. Galvanized metal need not be painted.

H. Prime Finish: Clean all metal surfaces receiving a baked enamel paint finish of oil, grease, and scale. Apply one coat of rust-resistant primer followed by a filler coat over uneven surfaces. Sand smooth and apply final coat of primer.

I. Baked Enamel Finish: Prime finish per above. Unless specified "prime finish" only, apply and bake three additional coats of enamel in the selected solid color.

J. Flooring: 5 layer methacrylate-based decorative chip flooring system.

K. Glass: Low-Iron heat-strengthened laminated safety glass, minimum 9/16" thick, conforming to ANSI Z97.1 and CPSC 16 CFR Part 1201.

2.4 CAR PERFORMANCE

A. Car Speed: ± 10% of contract speed under any loading condition. -

B. Car Capacity: Safely lower, stop and hold 125% of rated load.

C. Car Stopping Zone: ±1/4" under any loading condition.

D. Door Times: Seconds from start to fully open or fully closed:
1. Cars E1 & W1: Door open: 1.9 seconds. Door close: 2.9 seconds.

E. Car Floor-to-Floor Performance Time: Seconds from start of doors closing until doors are 3/4 open (1/2 open for side opening doors) and car level and stopped at next successive floor under any loading condition or travel direction:
   1. Cars E1 & W1: 14.5 seconds.

F. Pressure: Fluid system components shall be designed and factory tested for 500 p.s.i. Maximum operating pressure shall be 400 p.s.i.

G. Car Ride Quality:
   1. Acceleration and Deceleration: Smooth constant and not less than 1.5 feet/second^2 with an initial ramp between 0.5 and 0.75 second. Sustained Jerk: Not more than 6 feet/second^3.
   2. Measurement Standards: Measure and evaluate ride quality consistent with ISO 18738, using low pass cutoff frequency of 10 Hz and A95 peak-to-peak average calculations.

H. Noise and Vibration Control
   1. Airborne Noise: Measured noise level of elevator equipment and its operation shall not exceed 60 dBA inside car under any condition including door operation and car ventilation exhaust blower on its highest speed. Limit noise level in the machine room relating to elevator equipment and its operation to no more than 80 dBA. All dBA readings to be taken 3'-0" off the floor and 3'-0" from the equipment using the “A” weighted scale.
   2. Vibration Control: All elevator equipment provided under this contract, including power unit, controller, oil supply lines, and their supports shall be mechanically isolated from the building structure and electrically isolated from the building power supply and to each other to minimize the possibility of objectionable noise and vibrations being transmitted to occupied areas of the building.

2.5 OPERATION

A. Collective Microprocessor-Based:
   1. Operate car without attendant from pushbuttons in car and located at each floor. When car is available, automatically start car and dispatch it to floor corresponding to registered car or hall call. Once car starts, respond to registered calls in direction of travel and in the order the floors are reached.
   2. Do not reverse car direction until all car calls have been answered, or until all hall calls ahead of car and corresponding to the direction of car travel have been answered.
   3. Slow car and stop automatically at floors corresponding to registered calls, in the order in which they are approached in either direction of travel. As slowdown is initiated for a hall call, automatically cancel hall call. Cancel car calls in the same manner. Hold car at arrival floor an adjustable time interval to allow passenger transfer.
   4. Answer calls corresponding to direction in which car is traveling unless call in the opposite direction is highest (or lowest) call registered.
   5. Illuminate appropriate pushbutton to indicate call registration. Extinguish light when call is answered.

B. Other Items:
   1. Low Oil Control: In the event oil level is insufficient for travel to the top floor, provide controls to return elevator to the main level and park until oil is added.
   2. Load Weighing: Provide means for weighing car passenger load. Control system to provide dispatching at main floor in advance of normal intervals when car fills to

capacity. Provide hall call by-pass when the car is filled to preset percentage of rated capacity and traveling in down direction. Field adjustment range: 10% to 100%.

3. Anti-Nuisance Feature: If car loading relative to weight in car is not commensurate with number of registered car calls, or activation of door protection device is not commensurate with number of registered car calls, cancel car calls.
4. Independent Service: Provide controls for operation of each car from its pushbuttons only. Close doors by constant pressure on desired destination floor button or door close button. Open doors automatically upon arrival at selected floor.

C. Firefighters' Service: Provide equipment and operation in accordance with code requirements.

D. Automatic Car Stopping Zone: Stop car within 1/4" above or below the landing sill. Maintain stopping zone regardless of load in car, direction of travel, distance between landings.

E. Remote Monitoring and Information: Each controller shall provide the following output information, including data logging, fault logs operational events, performance information including car speed, floor to floor times, and door times. The system shall be real time, capable of driving remote color LCD monitors that continually display the status of each car and calls. Provide each Car with a complete, interactive elevator monitoring system.

1. The system shall concurrently display all units in a group and separate units on one screen in a graphical format and record the following information for each monitored unit:
    a. Car status:
        1) Group operational mode
        2) In/out of service
        3) Supervisory failure
        4) Location and direction of hall calls
        5) Phase I operation
    b. Individual car status – expandable menus:
        1) Direction of travel
        2) Independent service
        3) Hall button failure
        4) Inspection service
        5) Firefighters' service
        6) Position of elevator
        7) Door status (open, opening, closing, closed)
        8) Door dwell time
        9) Standby power operation/sequence
        10) Door detector
        11) Safety circuit
        12) Door zone
        13) Stop switch
        14) Alarm button
        15) Registered car calls
        16) Out of level
        17) Machine room temperature exceeds 95 degrees
        18) Stop counter (number of starts)
        19) Car speed
        20) Door open times
        21) Door close time
        22) Start to stop motion time

23) Emergency two-way communication device
24) Air conditioner/heater
25) Floor lockouts (car or hall)
26) Lobby recall
27) Firefighters' service
28) Up/down peak

c. Service Driven Outages:
1) Independent service
2) Car out of service
3) Lobby return, cleaning

d. Maintenance Activity "Indicators":
1) Top of car inspection
2) Hoistway access
3) Phase I and II
4) Independent service
5) Out of service

2. Faults monitored with visual and audible alarm, triggered by combinations of any of the above status points:
a. Safety circuit
b. Alarm bell
c. Stop switch
d. Emergency two-way communication device
e. Door reversal device
f. At least six user defined faults or events, i.e. water in pit, high machine room/cab temperature
g. Transmit email when any monitored faults occur.

3. If out of service 15 minutes, initiate email to designated address. If fault continues more than eight hours, send email hourly until car returned to service.

F. Reporting Requirements: System shall provide reports in color graphical format both on-screen and in printed form capability to conveniently switch from one report type to another and from one bank to another using minimal mouse clicks and key strokes. Reports shall be displayed after minimal waiting time. Data for all reports shall be continuously recorded and stored. Reports shall be displayed by simply selecting a date and time range, bank of equipment, and report type. Date and time range selections shall carry forward from one report selection to the next. Reporting functions shall be sub-divided into the following categories:

1. Traffic Reports:
a. Number of hall calls per floor (hall call distribution on a per floor basis)
b. Number of hall calls per hour (24 hour time-line)
c. Hall call waiting times per floor (hall call waiting time distribution on a per floor basis)
d. Hall call waiting times per hour (24 hour time-line)
e. Distributed hall call response graph (24 hour time-line)
f. Detailed hall call response graph (% calls / n seconds)
g. Longest wait times including floor number, wait time, date, time, and direction

2. Fault Reports:
a. Ten most recent faults (most recent faults listed per bank and per car)
b. Fault log – displays the entire fault log for a given time period
c. Faults per car (fault distribution on a per car basis)
d. Faults per floor (fault distribution on a per floor basis)
e. Faults per day/week/month (fault distribution on a per unit or group basis)

3. Car Use Statistics:
    a. Car use by hour (24 hour time-line of car calls, car starts, door cycles, delayed car, load by pass)
    b. Car use statistics (same as above, shown for an entire bank)
4. Group Service Log:
    a. Cars in service (24 hour time-line with text log of group availability of each car)
    b. Group functions (24 hour time-line with text log of actuation of group functions: Up peak, down peak, fire service, emergency power).
5. Playback capability: Provide means to playback last fault events:
    a. Provide means to store two years of data, prior to present.
    b. Provide means to search data and display 50 faults in sequence of occurrence.
    c. Provide means to transfer to permanent medium, CD, or approved equal.
    d. Provide means to print out playback data.

G. Motion Control: Microprocessor-based AC type with unit valve suitable for operation specified and capable of providing smooth, comfortable car acceleration and retardation. Limit the difference in car speed between full load and no load to not more than ±10% of the contract speed in either direction of travel.

H. Selective Leveling: Provide means to limit elevator car speed when traveling between adjacent floors.

I. Door Operation: Automatically open doors when car arrives at main floor. At expiration of normal dwell time, close doors. Reopen doors when car is designated for loading. Provide front or rear selective door operation.

J. Standby Lighting and Alarm: Car mounted battery unit with solid-state charger to operate alarm bell and car emergency lighting. Battery to be rechargeable with minimum five-year life expectancy. Include required transformer. Provide constant pressure test button in service compartment of car operating panel. Provide lighting integral with portion of normal car lighting system.

K. Battery Lowering Feature: Upon loss of normal power, provide controls to automatically lower the car(s) to the nearest lower landing. Upon arrival at the lowest landing, the elevator doors shall open automatically and remain open until regular door time has expired. The elevator shall then become deactivated. The standby power source shall be provided via 12-volt D.C. battery units installed in machine room, including solid-state charger and testing means mounted in a common metal container. Battery to be rechargeable lead acid or nickel cadmium with a ten-year life expectancy. Upon restoration of normal power, the elevator shall automatically resume normal operation.

L. Battery Standby Power Pack for Air Conditioner/Heater: Upon loss of normal power, standby power source shall be provided via 12-volt D. C. battery units installed in machine room, including solid-state charger and testing means mounted in a common metal container. Battery to be rechargeable lead acid or nickel cadmium with a ten-year life expectancy. Standby power source shall provide minimum four hours operation.

2.6 MACHINE ROOM EQUIPMENT

A. Arrange equipment in spaces shown on drawings.

B. Pump Unit: Assembled unit consisting of positive displacement pump, induction motor, master-type control valves combining safety features, holding, direction, bypass, stopping, manual lowering functions, shut off valve, oil reservoir with protected vent opening, oil level gauge, outlet strainer, drip pan, muffler, all mounted on isolating pads. Provide oil cooling unit and oil temperature thermostat to maintain oil at operating temperature. Provide Solid State soft start with closed transition. Design unit for 120 up starts/hour.

C. Landing System: Solid-state, magnetic, or optical type.

D. Controller: UL/CSA labeled.
1. Compartment: Securely mount all assemblies, power supplies, chassis switches, and relays, on a substantial self-supporting steel frame. Completely enclose equipment with covers. Provide means to prevent overheating.
2. Relay Design: Magnet operated with contacts of design and material to insure maximum conductivity, long life, and reliable operation without overheating or excessive wear. Provide wiping action and means to prevent sticking due to fusion. Contacts carrying high inductive currents shall be provided with arc deflectors or suppressors.
3. Microprocessor-Related Hardware:
    a. Provide built-in noise suppression devices which provide a high level of noise immunity on all solid-state hardware and devices.
    b. Provide power supplies with noise suppression devices.
    c. Isolate inputs from external devices (such as pushbuttons) with opto-isolation modules.
    d. Design control circuits with one leg of power supply grounded.
    e. Safety circuits shall not be affected by accidental grounding of any part of the system.
    f. System shall automatically restart when power is restored.
    g. System memory shall be retained in the event of power failure or disturbance.
    h. Equipment shall be provided with Electro Magnetic Interference (EMI) shielding within FCC guidelines.
4. Wiring: CSA labeled copper for factory wiring. Neatly route all wiring interconnections and securely attach wiring connections to studs or terminals.
5. Permanently mark components (relays, fuses, PC boards) with symbols shown on wiring diagrams.
6. Monitoring System Interface: Provide controller with serial data link through RJ45 Ethernet connection and install all devices necessary to monitor items outlined in Section 2.13. Elevator contractor responsible to connect monitoring system interface to machine room monitoring compartment and LAN. Wiring from the LAN to the machine room monitoring compartment by others.
7. Provide controller or machine mounted auxiliary lockable “open” disconnect if mainline disconnect is not in sight of controller and/or machine.
8. Provide control panel compliant with UL 508A SB.SCCR of 5000A required.

E. Muffler: Provide in discharge oil line near pump unit. Design shall dampen and absorb pulsation and noise in the flow of hydraulic fluid.

F. Piping and Oil: Provide piping, connections and oil for the system. Buried piping shall be secondarily contained with watertight Schedule 40 PVC sleeves between elevator machine room and pit, including heat tracing and pipe insulation. Threaded fittings shall be used to connect the steel piping from the power unit to the oil cooler. A minimum of two sound

isolation couplings shall be provided between the pump unit and oil line and the oil line and jack unit. Provide isolated pipe stands or hangers as required.

G. Shut-Off Valve: manual ball-type valve on line adjacent to pump unit.

H. Pressure Switch: Provide oil pressure sensitive switch in line to automatically close and prevent loss of oil in cylinder upon loss of pressure in oil supply line.

2.7 HOISTWAY EQUIPMENT

A. Guide Rails: Planed steel T-sections for car of suitable size and weight for the application, including seismic reactions, including brackets for attachment to building structure. Provide rail backing to meet code requirements. Provide bracketing, at top and bottom of floor beams. No additional structural points of rail attachment, other than those shown on the Contract Documents, will be provided.

B. Buffers: Spring type with blocking and support channels.

C. Scavenger Pump: Self-priming and self-lubricating type, with discharge pressure of 200 psi and 90 gph capacity. Include Check Valve and a mesh screen strainer at 200 microns. A float shall be included to prevent operation if the pit is flooded.

D. Hydraulic Jack Assembly:
1. Cylinders: Seamless steel pipe with dual seal. Design head to receive unit-type packing and provide means to collect oil at cylinder head and return automatically to oil reservoir. Provide secondary containment/cylinder protection. Provide cylinder stabilizer bracketing between guide rails as required. The piston packing seal shall be changed at the following intervals:

    1) Prior to putting the Car into service for beneficial use
    2) After the 12 month warranty period described in Section 1.8 – 3. above.

2. Plungers: Polished seamless steel tubing or pipe. If plunger length exceeds 24'-0", provide two or more sections not exceeding 16'-0" in length, or coordinate installation of longer unit at the jobsite. Join sections by internal threaded couplings. Multiple section jack units shall be factory polished while assembled and marked for proper future reassembly. Isolate plunger from car frames.

E. Jack Support and Fluid Shut-Off Valves: Provide steel pit channels to support jack assembly and transmit loads to building structure. Provide intermediate stabilizers as required. Provide manual on/off valves in oil lines adjacent to pump unit and jack units in pit.

F. Well Hole Casing:
1. Well hole is to be provided by Elevator Contractor. No additional compensation will be allowed for unforeseen conditions of any kind or spoil removal.
2. Install steel outer casing minimum 18" diameter. Install watertight sleeve over jack assembly for secondary containment prior to insertion into the outer casing. Extend PVC sleeve through pit floor slab to underside of jack support beams and seal with non-permeable membrane. Seal well opening at the pit floor with hydraulic quick setting cement. Provide PVC vision/access ports.

G. Valves:
1. Provide a pressure sensitive, mechanically-actuated seismic safety valve, conforming to ASME A17.1, Rule 3.19.4.7. Connect valve directly to jack assembly inlet.
2. Provide Shut-Off Valve, manual ball-type valve on-line adjacent to pump unit.
3. Provide easily accessible Overspeed Rupture Valve inside the hoistway elevator pit.

H. Terminal Stopping: Provide normal and final devices.

I. Electrical Wiring and Wiring Connections:
1. Conductors and Connections: Copper throughout with individual wires coded and connections on identified studs or terminal blocks. Use no splices or similar connections in wiring except at terminal blocks, control compartments, or junction boxes. Provide 10% spare conductors throughout. Run spare wires from car connection points to individual elevator controllers in the machine room.
2. Conduit: Galvanized steel conduit, EMT, or duct. Flexible conduit length not to exceed 3'-0". Flexible heavy-duty service cord may be used between fixed car wiring and car door switches for door protective devices. Conduit from the closest hoistway of each elevator group or single elevator to the firefighters' control room.
3. Traveling Cables: Flame and moisture-resistant outer cover. Prevent traveling cable from rubbing or chafing against hoistway or equipment within hoistway.
   a. Provide two RG-6/U coaxial CCTV cable and four pair of shielded 18 gauge wire within traveling cable from car controller to car top junction box, plus 3'-0" excess loop at both ends.
   b. Provide two pair of 18 gauge wire for CCTV power.
   c. Provide four pair of spare shielded communication wires in addition to those required to connect specified items.
   d. Tag spares in machine room. Provide cables from controller to car top.
4. Auxiliary Wiring: Provide conduit, wiring and connections for fire alarm initiating devices, emergency two-way communication system, paging speaker, CCTV, digital video display, security system, intercom, and announcement speaker and/or background music from the machine room junction box to each car controller in machine room.

J. Floor Numbers: Stencil paint 4" high floor designations in contrasting color on inside face of hoistway doors or hoistway fascia in location visible from within car.

2.8 HOISTWAY ENTRANCES

A. Complete entrances bearing fire labels from a nationally recognized testing laboratory approved within the governing jurisdiction.

B. Frames: 14 gauge hollow metal at all floors. Mitered and welded head to jamb assembly at all floors. Clad frames with finish material indicated in finish schedule at all floors. Provide Arabic floor designation/Braille plates, centered at 60" above finished floor, on both side jambs of all entrances. Provide plates at main egress landing with "Star" designation. Provide "Star of Life" designation plates at height of 78"-84" above finished floor on both side jambs at all floors. Braille indications shall be below Arabic floor designation. Provide cast floor designation/Braille plates as manufactured by SCS Elevator Products, Inc. or Vision Mark. Provide 14 gauge subframe for special architectural overlay finishes at all floors. Size clear opening of subframes at least 4" wider and 2" higher than clear finish opening.

C. Door Panels: Stainless steel with Glass Panels. Provide leading edges of center-opening doors with rubber astragals. Provide a minimum of two gibs per panel, one at leading and one at trailing edge with gibs in the sill groove entire length of door travel. Construct door panels with interlocking, stiffening ribs. Architectural metal cladding shall wrap around leading and trailing edge of panel and return a minimum of 1/2" on rear side of leading edge of panel at all floors. Provide safety retainers as required by Rule 2.11.11.8 of ASME A17.1.The top and bottom of horizontally sliding doors shall be provided with a means of retaining the door panels in position if the primary guiding means fail, and shall prevent displacement of the door panel (top and bottom) by not more than three fourths of an inch into the hoistway.

D. Entrance Equipment:
1. Door Hangers: Two-point hanger roller with neoprene roller surface and suspension with eccentric upthrust roller adjustment.
2. Door Tracks: Bar or formed, cold-drawn removable steel tracks with smooth roller contact surface.
3. Door Interlocks: Operable without retiring cam. Paint interlock box flat black.
4. Door Closers: Spring, spirator, or jamb/strut mounted counterweight type. Design and adjust to insure smooth, quiet mechanical close of doors.
5. Hoistway Door Unlocking Device: Provide unlocking device with escutcheon in door panel at all floors, with finish to match adjacent surface.

E. Sight Guards: 14 gauge, same material and finish as hoistway entrance door panels. Construct without sharp edges

F. Hoistway Access Switches: Mount in entrance frame side jamb at top and bottom floors. Provide switch with faceplate

G. Sills: Nickel Silver.

H. Sill Supports: Structural or formed steel designed to support door sill based upon car loading classification. Mount to eliminate need for grout under the sill.

I. Toe Guards and Hanger Covers: 14 gauge furniture steel with black enamel finish. Provide toe guards, and hanger covers. Provide car door interlock to prevent opening of car doors outside the unlocking zone.

J. Struts and Headers: Provide for vertical support of entrances and related material. Provide door open bumpers on entrances equipped with vertical struts.

K. Finish of Frames and Doors: Provide welded entrance frames with # 4 finish stainless steel finish.

L. Hoistway Access:
1. Hoistway Door Unlocking Device: Provide unlocking device with locking escutcheon collar in door panel at all floors, with finish to match adjacent surface.
2. Hoistway Access Switches: Mount in entrance frame side jamb at all terminal landings. Provide switch with approved faceplate.

2.9 CAR EQUIPMENT

A. Frame: Welded or bolted, rolled or formed steel channel construction to meet load classification specified.

B. Platform: Isolated type, constructed of steel, or steel and wood which is fireproofed on underside. Design and construct to accommodate load classification requirements. Provide Class “A” construction for passenger elevators. Provide recess to accommodate a minimum 1" floor thickness.

C. Platform Apron: Minimum 14 gauge steel, reinforced and braced to car platform, front and rear with black enamel finish.

D. Guide Shoes: Roller type with three or more spring dampened, sound-deadening rollers per shoe. Maximum roller rotation speed, 350 rpm. Solid type.

E. Finish Floor Covering: Provided:
1. Rubber tile 1/8" thick with 1" diameter by 0.025 high, raised circular pattern. Color selected by Architect.

F. Sills: One piece extrusion with extruded extension between car entrance columns to face of car front return. Extruded extension to match finish of sill.
1. Stainless steel.

G. Door Hangers: Two-point hanger roller with neoprene roller surface and suspension with eccentric upthrust roller adjustment.

H. Door Track: Bar or formed, cold-drawn removable steel track with smooth roller contact surface.

I. Door Header: Construct of minimum 12 gauge steel, shape to provide stiffening flanges.

J. Door Electrical Contact: Prohibit car operation unless car door is closed. Provide car door interlock to prevent opening of car doors outside the unlocking zone.

K. Door Clutch: Heavy-duty clutch, linkage arms, drive blocks and pickup rollers or cams to provide positive, smooth, quiet door operation. Design clutch so car doors can be closed, while hoistway doors remain open.

L. Restricted Opening Device: Provide car-door interlock to prevent opening of car doors outside unlocking zone.

M. Door Operator: High-speed, heavy-duty door operator capable of opening doors at no less than 2.5 fps. Accomplish reversal in no more than 2½" of door movement. Provide solid-state door control with closed loop circuitry to constantly monitor and automatically adjust door operation based upon velocity, position, and motor current. Provide a minimum of four controller-activated motion profiles, per floor, per door, to maintain consistent, smooth, and quiet door operation at all floors, regardless of door weight or varying air pressure. Acceptable closed-loop door operators:
1. KONE: AMD 2.0
2. Otis: AT 400 - i Motion II (Optional)

3. Thyssenkrupp: HD91 StarTrac
4. G.A.L.: MOVFR

N. Door Control Device:
1. Infrared Reopening Device:
   a. Black, fully enclosed device with full screen infrared matrix or multiple beams extending vertically along leading edge of each door panel to minimum height of 7'-0" above finished floor. Provide additional beams full height of door panels. Device shall prevent doors from closing and reverse doors at normal opening speed if beams are obstructed while doors are closing, except during nudging operation. In event of device failure, provide for automatic shutdown of car at floor level with doors open:
   b. Acceptable Infrared Reopening Device:
      1) Cegard/MAX-154 by CEDES
      2) Gatekeeper by Adams
      3) Magic Edge by Tri-Tronics
      4) Microlite by thyssenkrupp
      5) Microscan E by T.L. Jones
      6) Pana40 Plus by Janus
2. Nudging Operation: After beams of door control device are obstructed for a predetermined time interval (minimum 20.0-25.0 seconds), warning signal shall sound and doors shall attempt to close with a maximum of 2.5 foot pounds kinetic energy. Activation of the door open button shall override nudging operation and reopen doors.
3. Interrupted Beam Time: When beams are interrupted during initial door opening, hold door open a minimum of 3.0 seconds. When beams are interrupted after the initial 3.0 second hold open time, reduce time doors remain open to an adjustable time of approximately 1.0-1.5 seconds after beams are reestablished.
4. Differential Door Time: Provide separately adjustable timers to vary time that doors remain open after stopping in response to calls.
   a. Car Call: Hold open time adjustable between 3.0 and 5.0 seconds.
   b. Hall Call: Hold open time adjustable between 5.0 and 8.0 seconds. Use hall call time when car responds to coincidental calls.

O. Car Operating Panel:
1. Passenger: Two car operating panels with faceplates consisting of a metal box containing the vandal resistant operating fixtures, mounted behind the car stationary front return panel.
   a. Provide manually operated stop switch within Firefighters' Phase II compartment Arrange switch to sound group control panel distress signal when actuated.
   b. Provide "door open" button to stop and reopen doors or hold doors in open position.
   c. Provide "door close" button to activate door close cycle. Cycle shall not begin until normal do
2. Suitably identify floor buttons, alarm button, door open button, door close button, and emergency push-to-call button with approved cast tactile symbols recessed flush mounted fastenings. Configure plates per local building code accessibility standards including Braille. Locate top floor button at maximum height allowed above the car floor; no lower than 35" for emergency push-to-call button and alarm button.
3. Provide minimum 3/4" diameter raised floor pushbuttons that illuminate to indicate call registration.

4. Provide alarm button to ring bell located on car, and sound distress signal at group control panel. Illuminate button when actuated.
5. Provide Firefighters' devices and operation. Install firefighters' telephone jack with approved mounting in firefighter's compartment.
6. Provide lockable service compartment with recessed flush door. Door material and finish shall match car return panel or car operating panel faceplate. Inside surface of door shall contain an integral flush window for displaying the elevator operating permit. Include the following controls in lockable service cabinet with function and operating positions identified by permanent signage or engraved legend:
    a. Inspection switch.
    b. Light switch.
    c. Exhaust blower switch.
    d. Independent service switch.
    e. Constant pressure test button for battery pack emergency lighting.
    f. 120-volt, AC, GFCI protected electrical convenience duplex outlet.
    g. Keyed stop switch.
7. Provide black paint filled (except as noted), engraved, or approved etched signage as follows with approved size and font:
    a. Phase II firefighters' operating instructions on inside face of firefighters' compartment door. Engrave filled red firefighters' operation on outside face of compartment door.
    b. Building identification car number on main and auxiliary car operating panels.
    c. "No Smoking" on main and auxiliary car operating panels.
    d. Car capacity in pounds on main car operating panel.
    e. Loading classification and description on car operating panel.

P. Car Top Control Station: Mount to provide safe access and utilization while standing in an upright position on car top.

Q. Work Light and Duplex Plug Receptacle: GFCI protected outlet at top of car. Include on/off switch and lamp guard. Provide additional GFCI protected outlet on car top for installation of car CCTV.

R. Communication System:
1. Two-way communication instrument in car with automatic dialing, tracking, and recall features, with shielded wiring to car controller in machine room. Provide dialer with automatic rollover capability with minimum two numbers.
    a. Actuate two-way communication via "Help" button.
    b. Button or adjacent light jewel shall illuminate and flash when call is acknowledged.
    c. Button shall match car operating panel pushbutton design.
    d. Provide "Help" button tactile symbol, engraved signage, and Braille adjacent to button mounted integral with car front return panel.
2. Firefighters' communication jack in car and firefighters' panel jack bezel shall match adjacent controls.
3. Install remote speaker(s) provided under Item 1.01. E.1 in car behind front return panel with drilled speaker pattern, with shielded wiring to machine room junction box.
4. Provide two-way communication between car and machine room if required.

2.10 CAR ENCLOSURE

A. Passenger Elevator: Provide complete as specified herein and detailed on architectural drawings.
   1. Canopy: Reinforced 12 gauge furniture steel formed panels with lockable, contacted, hinged emergency exit. Interior finish white color reflective baked enamel.
   2. Front and Rear Return Panels: Reinforced 14 gauge furniture steel clad with minimum 16 gauge satin finish stainless steel with cutouts for applied car operating panel(s) and other equipment.
   3. Transom: Reinforced 14 gauge furniture steel clad with minimum 16 gauge satin finish stainless steel full width of enclosure with cutout for car position indicator.
   4. Car Door Panels: Reinforced minimum 16 gauge furniture steel clad with minimum 18 gauge satin finish stainless steel with Glass Panels. Same construction as hoistway door panels. Cladding shall wrap leading and trailing edge of panel a minimum of 1/2" on rear side.
   5. Base: Satin finish stainless steel.
   6. Interior Wall Finish: Stainless Steel with Glass Panels as specified by the Architect, and in conformance with ANSI Z.97.1.
   7. Ventilation: Morrison Products, Inc. three-speed model SOE No. 06-01055 exhaust blower mounted to car canopy on isolated rubber grommets. Exhaust blower shall meet noise and vibration criteria.
   8. Lighting: Provide LED fixtures with wiring and hookup. Coordinate with emergency lighting requirements
   9. Suspended Ceiling: Coordinate with Architectural Drawings.
   10. Handrails: Minimum 1¼" diameter stainless steel tubular grab bar with backing plates and captive nuts across side walls. Special design included in allowance in Interior Wall Finish item above. Bolt rails through car walls from back and mount on 1½" deep solid round stainless steel standoff spacers no more than 18" O.C. Return handrail/guardrail ends to car walls.
   11. Pads and Hooks for the Car. Three-piece removable pads. Two pads covering side walls and adjacent front returns and one covering rear wall. Provide cutouts to access main car operating panel.
   12. Cab Air Conditioner/Heater Unit: Provide self-contained cab air conditioner/heater on car top with concealed ducts, thermostat control, and evaporator. Isolate from car top to comply with noise and vibration requirements.

2.11 HALL CONTROL STATIONS

A. Pushbuttons: Provide one riser with flush mounted faceplates. Include pushbuttons for each direction of travel that illuminate to indicate call registration. Pushbutton design shall match car operating panel pushbuttons. Single riser at typical floors. Provide vandal resistant pushbutton and light assemblies. Provide LED illumination.

B. Phase I Fire Service fixture, including keyswitch, engraved operating instructions and illuminating jewel.

2.12 SIGNALS

A. Car Direction Lantern:
   1. Provide flush-mounted car lantern in all car entrance columns .

2. Illuminate up or down LED lights and sound tone once for up and twice for down direction prior to car arrival at floor. Illuminate light until the car doors start to close.
3. Sound level shall be adjustable from 20-80 dBA measured at 5'-0" in front of hall control station and 3'-0" off floor.
4. Provide adjustable car door dwell time to comply with ADA requirements relative to hall call notification time.
5. Provide vandal resistant lantern and light assemblies consisting of series of dots or lines for maximum visibility.

B. Car Position Indicator:

1. In addition to position and direction, the display shall interface with the elevator control system to provide system-based messages for the following conditions at a minimum:
   a. Firefighters' Service, Phase I
   b. Independent Service
   c. Car-to-Lobby Activated

C. Faceplate Material and Finish: Satin finish stainless steel, all fixtures. Tamper resistant fasteners for all fastenings exposed to the public.
1. Car Direction Lantern
2. Car Position Indicator
3. Hoistway Access Switch
4. Phase I Keyswitch Faceplate

D. Floor Passing Tone: Provide an audible tone of no less than 20 decibels and frequency of no higher than 1500 Hz, to sound as the car passes or stops at a floor served.

E. Firefighters' Control Panel: Locate in building fire control room. Fixture faceplate, stainless steel satin finish, including the following features:
1. Car position and direction indicator (digital-readout or color SVGA display type). Identify each position indicator with car number.
2. Indicator showing operating status of car.
3. Manual car standby power selection switches and power status indicators.
4. Two-position firefighters' emergency return switches and indicators with engraved instructions filled red.
5. Firefighters' telephone jack.
6. Fixtures and monitor shall be located as directed by Architect. Where applicable, identify all indicators and manual switches with appropriate engraving. Provide conduit and wiring to control panel. Coordinate size and location with Building Console Supplier.

F. Firefighters' Key Box: Flush-mounted box with lockable hinged cover. Engrave instructions for use on cover per Local Fire Authority requirements.

1. System Performance Monitoring:
   a. Hall call registration information: Provide memory capacity for at least the preceding five, 24-hour periods, in blocks of 5- or 15-minute segments, running hour to hour (i.e., 2:00 p.m. to 3:00 p.m.)
      1) Visual and printed summary of hall call registration events by floor, direction, and duration, totaled in 5- or 15-minute segments during any 60-minute block using an internal clock.

2) Visual and printed summary of hall call registration duration averaged for 5- or 15-minute and hourly periods.
3) Visual and printed summary of percentage of hall calls answered within 30 and 60 seconds in each 5- or 15-minute and hourly periods.
4) Visual and printed summary of time periods during which individual cars are not in group operation (operating separately or out of service).

b. Accumulate system fault data including nature of fault, time, and day. Store and retrieval capabilities for minimum 30-day period.

2. Provide printer to produce a hard copy of stored data. Provide directions and software to accomplish information retrieval.

2.13 INTERCOM AND DISTRESS SIGNAL SYSTEM

A. General: Provide intercommunication system for Car. Include all wiring between elevator hoistways and control panels. Include the following stations:

Station Location	Type Station	Selection Buttons to Call
Elevator Machine Room	Master	Control Panel
Lobby Control Panel	Master	Machine Room
Firefighters' Control Panel	Master	Machine Room
Elevator	Remote	Liftnet Monitoring Station

B. Basic Equipment:

1. Amplifier providing static-free voice transmission with adequate volume and minimum distortion at all stations, with pre-amplifier capable of receiving voice and music inputs from building and emergency building communication system.
2. Activation of emergency building communication system overrides all other conversations and permits one-way conversation to all master stations in system.
3. Master Stations:
   a. Speaker-microphone combination and/or handset for two-way communication.
   b. Selection buttons to enable communication with all master stations. Maintain continual reception of hands-free reply from station when a selected button is depressed.
   c. Two-Position "Talk/Listen" Button: Press to talk; release to listen.
   d. Illuminate "in use" light when any master station is being used.
   e. Reset button to make system available for use by any master station.
   f. Volume control knob for adjustment of incoming volume.
   g. Button to establish communications with all stations.
   h. Distress light in lobby panel which illuminates when "push to call" button or alarm button in car is actuated. Energize distress light and buzzer or chime until intercom selection button for that car has been depressed. Sound buzzer or chime in lobby panel simultaneously with illumination of distress light.
4. Remote Stations:
   a. Station in car shall be activated by "push to call," two-way communication button. "Push to call" button shall illuminate and flash when call is acknowledged. Button shall match car operating panel pushbutton design. Provide uppercase "PUSH TO CALL," "HELP ON THE WAY" engraved signage adjacent to button. Provide "push to call" button tactile symbol, engraved signage, and Braille adjacent to button.

b. Locate car microphone and speaker, or transceiver/speaker combination behind front return panel.

C. Station Housings:
1. House master station in machine room in a metal compartment with baked enamel finish. Attach to the group elevator supervisory control panel or wall mount. Provide communication handset with 25'-0" long cord.
2. Provide control center master intercoms with stainless steel satin finish faceplates and engraved operating instructions. Coordinate faceplate size and installation of units with building Console Supplier.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to beginning installation of equipment examine hoistway and machine room areas. Verify no irregularities exist which affect execution of work specified.

B. Do not proceed with installation until work in place conforms to project requirements.

3.2 INSTALLATION

A. Install all equipment in accordance with Contractor's instructions, referenced codes, specification, and approved submittals.

B. Install machine room equipment with clearances in accordance with referenced codes and specification.

C. Install all equipment so it may be easily removed for maintenance and repair.

D. Install all equipment for ease of maintenance.

E. Install all equipment to afford maximum accessibility, safety, and continuity of operation.

F. Remove oil, grease, scale, and other foreign matter from the following equipment and apply one coat of field-applied machinery enamel.
1. All exposed equipment and metal work installed as part of this work which does not have architectural finish.
2. Machine room equipment, hoistway equipment including guide rails, guide rail brackets, and pit equipment.
3. Neatly touch up damaged factory-painted surfaces with original paint color. Protect machine-finish surfaces against corrosion.

G. Clean all architectural finishes and replace or restore any surfaces damaged during construction to like new condition.

H. Final payment, for retainage of 10%, shall not be made for the installation work prior to the conclusion of the Warranty / Maintenance period.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Operating Test: Load elevator to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.

C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 ADJUSTING

A. Install hydraulic jack assembly and guide rails plumb and align vertically with tolerance of 1/16" in 100'-0". Secure guide rail joints without gaps and file any irregularities to a smooth surface.

B. Lubricate all equipment in accordance with Contractor's instructions.

C. Adjust motors, valves, controllers, leveling switches, limit switches, stopping switches, door operators, interlocks, and safety devices to achieve required performance levels.

3.5 CLEANUP

A. Keep work areas orderly and free from debris during progress of project. Remove packaging materials on a daily basis.

B. Remove all loose materials and filings resulting from work.

C. Clean machine room equipment and floor.

D. Clean pit equipment and floor.

E. Clean hoistways, car, car enclosure, entrances, operating, and signal fixtures.

3.6 TEST RESULTS:

A. Under any load obtain specified contract speed, performance times, stopping accuracy without re-leveling, and ride quality to satisfaction of Consultant. Tests may be conducted under no load, balanced load, and full load conditions.

B. Consultant may test temperature rise in motor windings limited to 50° Celsius above ambient. A full-capacity one hour running test, stopping at each floor for ten seconds in up and down directions, may be required.

C. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevators.

D. Check operation of each elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

1. Engage Elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items which cannot be refinished in the field to the shop, make required repairs, and refinish entire unit, or provide new units as required.

END OF SECTION

SECTION 14 24 00

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SECTION 142400
HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Hydraulic elevators as follows:
   1. One passenger elevator, Car located at the Scarsdale Station (W1).

B. Related Requirements:
   1. Division 01 Section – General Requirements
   2. Division 03 Section – Concrete
   3. Division 04 Section – Masonry
   4. Division 05 Section – Metals
   5. Division 06 Section – Wood, Plastics and Composites
   6. Division 09 Section – Finishes
   7. Division 22 Section – Plumbing
   8. Division 23 Section – Heating, Ventilating and Air Conditioning (HVAC)
   9. Division 26 Section – Electrical
   10. Division 27 Section – Communications
   11. Division 28 Section – Fire Alarm Systems

1.2 ALLOWANCE

A. Elevator Car Allowances: Provide finished passenger elevator cars under the elevator car allowance which includes furnishing and installing the following:
   1. Car wall finishes including trim.
   2. Car ceiling finishes including lighting, wring, and coordination of battery-operated emergency lighting.
   3. Car door finishes.
   4. Car light fixtures.
   5. Handrails.
   6. Cutouts and other provisions for installing elevator signal equipment in cars.
   7. Mounting for protective pads

1.3 DEFINITIONS

A. Terms used are defined in the latest edition of the Safety Code for Elevators and Escalators, ASME A17.1.

1.4 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44 (2013)

B. Accessibility Requirements: Comply with 2010 ADA standards for Accessible Design and with ICC A117.1. Comply with Uniform Federal Accessibility Standard, UFAS.
   1. The term “withstand” means the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event.
   2. Project Seismic Design Category: B.

3. Elevator Component Importance Factor (Ip): 1.0
4. Design Spectral Response Acceleration (SDS): 0.29

1.5 SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems. Include product data for signal fixtures, lights, graphics, Braille plates, and details of mounting provisions.

B. Shop Drawings:
1. Include plans, elevations, sections, and large-scale details indicating openings at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
2. Include large-scale layout of car operating panel.
3. Indicate maximum dynamic and static loads imposed on building structure at points of support and maximum and average power demands.
4. Power Confirmation Information: Include motor horsepower, code letter, starting current, full - load running current, and demand factor. Provide engineered power consumption estimates based on 120 starts per hour.

C. Samples for Initial Selection: For finishes involving surface treatment, paint or color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes:
1. Samples of sheet materials: 3" (75 mm) square.
2. Running trim members: 4" (100 mm) lengths.

E. Operation and Maintenance Data:
1. For elevators to include in emergency, operation, and maintenance manuals.
2. In addition to items specified in Division 01 Section “General Requirements” include diagnostic and repair information available to manufacturer’s and Installer’s maintenance personnel.

F. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

G. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard two-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.6 QUALITY ASSURANCE

A. Compliance with Regulatory Agencies: Comply with most stringent applicable provisions of following codes, laws, and/or authorities, including revisions and changes in effect:
1. New York State Building Code (IBC 2015) w/2017 Supplements
2. Safety Code for Elevators and Escalators, ASME A17.1 (2013)
3. Guide for Inspection of Elevators, Escalators, and Moving Walks, ASME A17.2
4. Elevator and Escalator Electrical Equipment, ASME A17.5

5. National Electrical Code, NFPA 70 (2017)
6. New York State - American with Disabilities Act (2010)
7. New York State Fire Code (2018) [IFC 2015]
8. Requirements of most stringent provision of local authority having jurisdiction.
9. Life Safety Code, NFPA101

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver material in Contractor's original unopened protective packaging.

B. Store material in original protective packaging. Prevent soiling, physical damage, or moisture damage.

C. Protect equipment and exposed finishes from damage and stains during transportation and construction.

1.8 WARRANTY

1. Manufacturer's Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
2. Failures include, but are not limited to: operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
3. Warranty Period: One year from date of Substantial Completion. The Warranty Period should conclude with a 30 day trouble free period. If any elevator outages or unscheduled repairs are performed during this period, not including those due to vandalism of force majeure, then the Warranty period is extended for an additional 30 days.

1.9 MAINTENANCE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
1. Perform maintenance during normal working hours.
2. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of 60 minutes or less.

The Maintenance Period should conclude with a 30 day trouble free period. If any elevator outages or unscheduled repairs are performed during this period, not including those due to vandalism of force majeure, then the Maintenance period is extended for an additional 30 days.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide borehole hydraulic passenger elevators or comparable product by one of the following:

1. Berringer Elevator Co.
2. Canton Elevator Inc.
3. Elevator Equipment Corporation
4. Elevator Systems (ESI) – Elevator Controller
5. Galaxy – Elevator Controller
6. Leistritz Elevator Corp.
7. Minnesota Elevator, Inc.
8. Monitor Elevator Products
9. Otis Elevator Company
10. Schindler Elevator Corporation
11. Thyssenkrupp Elevator

2.2 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Passenger Elevators Description:
Elevator Identification: Car W1

1. Capacity: 4,000 lbs.
2. Class of Loading: Class A
3. Contract Speed: 125 fpm
4. Machine: Submersible Hydraulic pump
5. Machine Location: Adjacent
6. Operational Control: Single automatic, Collective Microprocessor-Based System
7. Motor Control: Single speed AC with SCR soft start with closed transition
8. Power Characteristics: 208 Volts, 3 Phase, 60 Hertz
9. Stops and Openings: 1 front; 1 rear
10. Floors Served: Street Level, Platform Level, Overpass Level
11. Travel: 15'-2" ±
12. Platform Size: 7'-10" wide X 7'-4" deep
13. Minimum Clear Inside Car: 7'-0" wide x 6'-0" deep
14. Entrance Size: 4'-0" wide X 7'-0" high
15. Entrance Type: Single-speed, center-opening
16. Door Operation: High-speed, heavy-duty door operator. Minimum Opening Speed: 2½ fps
17. Door Protection: Three-dimensional infrared, full screen device, with differential timing, nudging, and interrupted beam time
18. Hydraulic Type: Direct plunger
19. Guide Rails: Planed Steel Tees
20. Buffers: Spring
21. Car Enclosure:
    a. stationary returns
    b. Stainless Steel and Glass enclosure and Car interior finishes provided under this section. Clear height under canopy, Car 8': 0"
    c. Car interior ventilation.
    d. Pad buttons or hooks and vinyl-covered pads.

22. Signal Fixtures: LED illumination. NEMA 4 and NEMA 12 design for weather resistance, vandal resistant buttons and fixtures.
    a. Hall and Car Pushbutton Stations:
        1) Single hall pushbutton riser
        2) Dual car operating panels
        3) NEMA-4, NEMA-12, Vandal resistant car and hall pushbuttons
    b. Car Position Indicators:
        1) Digital in car station with car direction arrows
    c. Car Direction Lanterns: All car entrance columns with volume adjustable electronic chime or tone, vandal-resistant assembly.
23. Communication System:
    a. Intercom with Distress Signal

    b. Self-Dialing, Vandal Resistant, Push to Call, Two-Way Communication System with Recall, Tracking, and Voiceless Communication
24. Additional Features:
    a. Hoistway access switches, top and bottom floors
    b. Hoistway door unlocking device, all floors
    c. Anti-nuisance feature
    d. CCTV provisions, all cars
    e. Firefighters' control panel, remote conduit, and wiring
    f. Sill support angles
    g. Firefighters' telephone jack
    h. Liftnet Remote Monitoring System
    i. Provide pit access ladder(s)
    j. System diagnostic means and instructions
    k. Platform Isolation, Jack to Platen Connections
    l. Hydraulic Pump Unit with Oil Tank, UV5A Control Valve Unit, or approved equal, and Controller Sound Isolation
    m. Jack Hole, Outer Casing, and Watertight PVC Inner Casing with Secondary Containment Provisions

2.3 MATERIALS

A. Steel:
1. Sheet Steel (Furniture Steel for Exposed Work): Stretcher-leveled, cold-rolled, commercial quality carbon steel, complying with ASTM A366, matte finish.
2. Sheet Steel (for Unexposed Work): Hot-rolled, commercial quality carbon steel, pickled and oiled, complying with ASTM A568/A568M-03.
3. Structural Steel Shapes and Plates: ASTM A36.

B. Stainless Steel: Type 316 complying with ASTM A240, with standard tempers and hardness required for fabrication, strength, and durability. Apply mechanical finish on fabricated work in the locations shown or specified, Federal Standard and NAAMM nomenclature, with texture and reflectivity required to match Architect's sample. Protect with adhesive paper covering.
1. No. 4 Satin: Directional polish finish. Graining directions as shown or, if not shown, in longest dimension.
2. Textured: Provide 5WL as manufactured by Rigidized Metals or Windsor pattern as manufactured by Rimex Metals or approved equal with .050 inches mean pattern depth with bright directional polish (No. 4 satin finish).
3. Burnished: Non-directional, random abrasion pattern.

C. Aluminum: Extrusions per ASTM B221; sheet and plate per ASTM B209.

D. Plastic Laminate: ASTM E84 Class A and NEMA LD3.1, Fire-Rated Grade (GP-50), Type 7, 0.050" ±.005" thick, color and texture as follows:
1. Exposed Surfaces: Color and texture selected by Architect.
2. Concealed Surfaces: Contractor's standard color and finish.

E. Fire-Retardant Treated Particle Board Panels: Minimum 3/4" thick backup for natural finished wood and plastic laminate veneered panels, edged and faced as shown, provided with suitable anti-warp backing; meet ASTM E84 Class "I" rating with a flame-spread rating of 25 or less, registered with Local Authorities for elevator finish materials.

F. Natural Finish Wood Veneer: Standard thickness, 1/40" thoroughly dried conforming to ASME/HPMA HP-1983, Premium Grade. Place veneer, tapeless spliced with grain running in direction shown, belt, and polish sanded, book-matched. Species and finish designated and approved by Architect.

G. Paint: Clean exposed metal parts and assemblies of oil, grease, scale, and other foreign matter and factory paint one shop coat of standard rust-resistant primer. After erection, provide one finish coat of industrial enamel paint. Galvanized metal need not be painted.

H. Prime Finish: Clean all metal surfaces receiving a baked enamel paint finish of oil, grease, and scale. Apply one coat of rust-resistant primer followed by a filler coat over uneven surfaces. Sand smooth and apply final coat of primer.

I. Baked Enamel Finish: Prime finish per above. Unless specified "prime finish" only, apply and bake three additional coats of enamel in the selected solid color.

J. Flooring: 5 layer methacrylate-based decorative chip flooring system.

K. Glass: Low-Iron heat-strengthened laminated safety glass, minimum 9/16" thick, conforming to ANSI Z97.1 and CPSC 16 CFR Part 1201.

2.4 CAR PERFORMANCE

A. Car Speed: ± 10% of contract speed under any loading condition. -

B. Car Capacity: Safely lower, stop and hold 125% of rated load.

C. Car Stopping Zone: ±1/4" under any loading condition.

D. Door Times: Seconds from start to fully open or fully closed:
1. Car Door open: 1.9 seconds. Car Door close: 2.9 seconds.

E. Car Floor-to-Floor Performance Time: Seconds from start of doors closing until doors are 3/4 open (1/2 open for side opening doors) and car level and stopped at next successive floor under any loading condition or travel direction:
1. Cars W1: 14.5 seconds.

F. Pressure: Fluid system components shall be designed and factory tested for 500 p.s.i. Maximum operating pressure shall be 400 p.s.i.

G. Car Ride Quality:
1. Acceleration and Deceleration: Smooth constant and not less than 1.5 feet/second^2 with an initial ramp between 0.5 and 0.75 second. Sustained Jerk: Not more than 6 feet/second^3.
2. Measurement Standards: Measure and evaluate ride quality consistent with ISO 18738, using low pass cutoff frequency of 10 Hz and A95 peak-to-peak average calculations.

H. Noise and Vibration Control
1. Airborne Noise: Measured noise level of elevator equipment and its operation shall not exceed 60 dBA inside car under any condition including door operation and car ventilation exhaust blower on its highest speed. Limit noise level in the machine room relating to elevator equipment and its operation to no more than 80 dBA. All dBA readings to be taken 3'-0" off the floor and 3'-0" from the equipment using the "A" weighted scale.
2. Vibration Control: All elevator equipment provided under this contract, including power unit, controller, oil supply lines, and their supports shall be mechanically isolated from the building structure and electrically isolated from the building power supply and to each other to minimize the possibility of objectionable noise and vibrations being transmitted to occupied areas of the building.

2.5 OPERATION

A. Collective Microprocessor-Based:
1. Operate car without attendant from pushbuttons in car and located at each floor. When car is available, automatically start car and dispatch it to floor corresponding to registered car or hall call. Once car starts, respond to registered calls in direction of travel and in the order the floors are reached.
2. Do not reverse car direction until all car calls have been answered, or until all hall calls ahead of car and corresponding to the direction of car travel have been answered.
3. Slow car and stop automatically at floors corresponding to registered calls, in the order in which they are approached in either direction of travel. As slowdown is initiated for a hall call, automatically cancel hall call. Cancel car calls in the same manner. Hold car at arrival floor an adjustable time interval to allow passenger transfer.
4. Answer calls corresponding to direction in which car is traveling unless call in the opposite direction is highest (or lowest) call registered.
5. Illuminate appropriate pushbutton to indicate call registration. Extinguish light when call is answered.

B. Other Items:
1. Low Oil Control: In the event oil level is insufficient for travel to the top floor, provide controls to return elevator to the main level and park until oil is added.
2. Load Weighing: Provide means for weighing car passenger load. Control system to provide dispatching at main floor in advance of normal intervals when car fills to capacity. Provide hall call by-pass when the car is filled to preset percentage of rated capacity and traveling in down direction. Field adjustment range: 10% to 100%.
3. Anti-Nuisance Feature: If car loading relative to weight in car is not commensurate with number of registered car calls, or activation of door protection device is not commensurate with number of registered car calls, cancel car calls.
4. Independent Service: Provide controls for operation of each car from its pushbuttons only. Close doors by constant pressure on desired destination floor button or door close button. Open doors automatically upon arrival at selected floor.

C. Firefighters' Service: Provide equipment and operation in accordance with code requirements.

D. Automatic Car Stopping Zone: Stop car within 1/4" above or below the landing sill. Maintain stopping zone regardless of load in car, direction of travel, distance between landings.

E. Remote Monitoring and Information: Each controller shall provide the following output information, including data logging, fault logs operational events, performance information including car speed, floor to floor times, and door times. The system shall be real time, capable of driving remote color LCD monitors that continually display the status of each car and calls. Provide each Car with a complete, interactive elevator monitoring system.

1. The system shall concurrently display all units in a group and separate units on one screen in a graphical format and record the following information for each monitored unit:
   a. Car status:
      1) Group operational mode
      2) In/out of service
      3) Supervisory failure
      4) Location and direction of hall calls
      5) Phase I operation
   b. Individual car status – expandable menus:
      1) Direction of travel
      2) Independent service
      3) Hall button failure
      4) Inspection service
      5) Firefighters' service
      6) Position of elevator
      7) Door status (open, opening, closing, closed)
      8) Door dwell time
      9) Standby power operation/sequence
      10) Door detector
      11) Safety circuit
      12) Door zone
      13) Stop switch
      14) Alarm button
      15) Registered car calls
      16) Out of level
      17) Machine room temperature exceeds 95 degrees
      18) Stop counter (number of starts)
      19) Car speed
      20) Door open times
      21) Door close time
      22) Start to stop motion time
      23) Emergency two-way communication device
      24) Air conditioner/heater
      25) Floor lockouts (car or hall)
      26) Lobby recall
      27) Firefighters' service
      28) Up/down peak
   c. Service Driven Outages:
      1) Independent service
      2) Car out of service

3) Lobby return, cleaning

d. Maintenance Activity "Indicators":

1) Top of car inspection
2) Hoistway access
3) Phase I and II
4) Independent service
5) Out of service

2. Faults monitored with visual and audible alarm, triggered by combinations of any of the above status points:
   a. Safety circuit
   b. Alarm bell
   c. Stop switch
   d. Emergency two-way communication device
   e. Door reversal device
   f. At least six user defined faults or events, i.e. water in pit, high machine room/cab temperature
   g. Transmit email when any monitored faults occur.
3. If out of service 15 minutes, initiate email to designated address. If fault continues more than eight hours, send email hourly until car returned to service.

F. Reporting Requirements: System shall provide reports in color graphical format both on-screen and in printed form capability to conveniently switch from one report type to another and from one bank to another using minimal mouse clicks and key strokes. Reports shall be displayed after minimal waiting time. Data for all reports shall be continuously recorded and stored. Reports shall be displayed by simply selecting a date and time range, bank of equipment, and report type. Date and time range selections shall carry forward from one report selection to the next. Reporting functions shall be sub-divided into the following categories:

1. Traffic Reports:
   a. Number of hall calls per floor (hall call distribution on a per floor basis)
   b. Number of hall calls per hour (24 hour time-line)
   c. Hall call waiting times per floor (hall call waiting time distribution on a per floor basis)
   d. Hall call waiting times per hour (24 hour time-line)
   e. Distributed hall call response graph (24 hour time-line)
   f. Detailed hall call response graph (% calls / n seconds)
   g. Longest wait times including floor number, wait time, date, time, and direction
2. Fault Reports:
   a. Ten most recent faults (most recent faults listed per bank and per car)
   b. Fault log – displays the entire fault log for a given time period
   c. Faults per car (fault distribution on a per car basis)
   d. Faults per floor (fault distribution on a per floor basis)
   e. Faults per day/week/month (fault distribution on a per unit or group basis)
3. Car Use Statistics:
   a. Car use by hour (24 hour time-line of car calls, car starts, door cycles, delayed car, load by pass)
   b. Car use statistics (same as above, shown for an entire bank)
4. Group Service Log:
   a. Cars in service (24 hour time-line with text log of group availability of each car)
   b. Group functions (24 hour time-line with text log of actuation of group functions: Up peak, down peak, fire service, emergency power).
5. Playback capability: Provide means to playback last fault events:

a. Provide means to store two years of data, prior to present.
b. Provide means to search data and display 50 faults in sequence of occurrence.
c. Provide means to transfer to permanent medium, CD, or approved equal.
d. Provide means to print out playback data.

G. Motion Control: Microprocessor-based AC type with unit valve suitable for operation specified and capable of providing smooth, comfortable car acceleration and retardation. Limit the difference in car speed between full load and no load to not more than ±10% of the contract speed in either direction of travel.

H. Selective Leveling: Provide means to limit elevator car speed when traveling between adjacent floors.

I. Door Operation: Automatically open doors when car arrives at main floor. At expiration of normal dwell time, close doors. Reopen doors when car is designated for loading. Provide front or rear selective door operation.

J. Standby Lighting and Alarm: Car mounted battery unit with solid-state charger to operate alarm bell and car emergency lighting. Battery to be rechargeable with minimum five-year life expectancy. Include required transformer. Provide constant pressure test button in service compartment of car operating panel. Provide lighting integral with portion of normal car lighting system.

K. Battery Lowering Feature: Upon loss of normal power, provide controls to automatically lower the car(s) to the nearest lower landing. Upon arrival at the lowest landing, the elevator doors shall open automatically and remain open until regular door time has expired. The elevator shall then become deactivated. The standby power source shall be provided via 12-volt D.C. battery units installed in machine room, including solid-state charger and testing means mounted in a common metal container. Battery to be rechargeable lead acid or nickel cadmium with a ten-year life expectancy. Upon restoration of normal power, the elevator shall automatically resume normal operation.

L. Battery Standby Power Pack for Air Conditioner/Heater: Upon loss of normal power, standby power source shall be provided via 12-volt D. C. battery units installed in machine room, including solid-state charger and testing means mounted in a common metal container. Battery to be rechargeable lead acid or nickel cadmium with a ten-year life expectancy. Standby power source shall provide minimum four hours operation.

2.6 MACHINE ROOM EQUIPMENT

A. Arrange equipment in spaces shown on drawings.

B. Pump Unit: Assembled unit consisting of positive displacement pump, induction motor, master-type control valves combining safety features, holding, direction, bypass, stopping, manual lowering functions, shut off valve, oil reservoir with protected vent opening, oil level gauge, outlet strainer, drip pan, muffler, all mounted on isolating pads. Provide oil cooling unit and oil temperature thermostat to maintain oil at operating temperature. Provide Solid State soft start with closed transition. Design unit for 120 up starts/hour.

C. Landing System: Solid-state, magnetic, or optical type.

D. Controller: UL/CSA labeled.
   1. Compartment: Securely mount all assemblies, power supplies, chassis switches, and relays, on a substantial self-supporting steel frame. Completely enclose equipment with covers. Provide means to prevent overheating.
   2. Relay Design: Magnet operated with contacts of design and material to insure maximum conductivity, long life, and reliable operation without overheating or excessive wear. Provide wiping action and means to prevent sticking due to fusion. Contacts carrying high inductive currents shall be provided with arc deflectors or suppressors.
   3. Microprocessor-Related Hardware:
      a. Provide built-in noise suppression devices which provide a high level of noise immunity on all solid-state hardware and devices.
      b. Provide power supplies with noise suppression devices.
      c. Isolate inputs from external devices (such as pushbuttons) with opto-isolation modules.
      d. Design control circuits with one leg of power supply grounded.
      e. Safety circuits shall not be affected by accidental grounding of any part of the system.
      f. System shall automatically restart when power is restored.
      g. System memory shall be retained in the event of power failure or disturbance.
      h. Equipment shall be provided with Electro Magnetic Interference (EMI) shielding within FCC guidelines.
   4. Wiring: CSA labeled copper for factory wiring. Neatly route all wiring interconnections and securely attach wiring connections to studs or terminals.
   5. Permanently mark components (relays, fuses, PC boards) with symbols shown on wiring diagrams.
   6. Monitoring System Interface: Provide controller with serial data link through RJ45 Ethernet connection and install all devices necessary to monitor items outlined in Section 2.13. Elevator contractor responsible to connect monitoring system interface to machine room monitoring compartment and LAN. Wiring from the LAN to the machine room monitoring compartment by others.
   7. Provide controller or machine mounted auxiliary lockable “open” disconnect if mainline disconnect is not in sight of controller and/or machine.
   8. Provide control panel compliant with UL 508A SB.SCCR of 5000A required.

E. Muffler: Provide in discharge oil line near pump unit. Design shall dampen and absorb pulsation and noise in the flow of hydraulic fluid.

F. Piping and Oil: Provide piping, connections and oil for the system. Buried piping shall be secondarily contained with watertight Schedule 40 PVC sleeves between elevator machine room and pit, including heat tracing and pipe insulation. Threaded fittings shall be used to connect the steel piping from the power unit to the oil cooler. A minimum of two sound isolation couplings shall be provided between the pump unit and oil line and the oil line and jack unit. Provide isolated pipe stands or hangers as required.

G. Shut-Off Valve: manual ball-type valve on line adjacent to pump unit.

H. Pressure Switch: Provide oil pressure sensitive switch in line to automatically close and prevent loss of oil in cylinder upon loss of pressure in oil supply line.

2.7 HOISTWAY EQUIPMENT

A. Guide Rails: Planed steel T-sections for car of suitable size and weight for the application, including seismic reactions, including brackets for attachment to building structure. Provide rail backing to meet code requirements. Provide bracketing, at top and bottom of floor beams. No additional structural points of rail attachment, other than those shown on the Contract Documents, will be provided.

B. Buffers: Spring type with blocking and support channels.

C. Scavenger Pump: Self-priming and self-lubricating type, with discharge pressure of 200 psi and 90 gph capacity. Include Check Valve and a mesh screen strainer at 200 microns. A float shall be included to prevent operation if the pit is flooded.

D. Hydraulic Jack Assembly:
1. Cylinders: Seamless steel pipe with dual seal. Design head to receive unit-type packing and provide means to collect oil at cylinder head and return automatically to oil reservoir. Provide secondary containment/cylinder protection. Provide cylinder stabilizer bracketing between guide rails as required. The piston packing seal shall be changed at the following intervals:

    1) Prior to putting the Car into service for beneficial use
    2) After the 12 month warranty period described in Section 1.8 – 3. above.

2. Plungers: Polished seamless steel tubing or pipe. If plunger length exceeds 24'-0", provide two or more sections not exceeding 16'-0" in length, or coordinate installation of longer unit at the jobsite. Join sections by internal threaded couplings. Multiple section jack units shall be factory polished while assembled and marked for proper future reassembly. Isolate plunger from car frames.

E. Jack Support and Fluid Shut-Off Valves: Provide steel pit channels to support jack assembly and transmit loads to building structure. Provide intermediate stabilizers as required. Provide manual on/off valves in oil lines adjacent to pump unit and jack units in pit.

F. Well Hole Casing:
1. Well hole is to be provided by Elevator Contractor. No additional compensation will be allowed for unforeseen conditions of any kind or spoil removal.
2. Install steel outer casing minimum 18" diameter. Install watertight sleeve over jack assembly for secondary containment prior to insertion into the outer casing. Extend PVC sleeve through pit floor slab to underside of jack support beams and seal with non-permeable membrane. Seal well opening at the pit floor with hydraulic quick setting cement. Provide PVC vision/access ports.

G. Valves:
1. Provide a pressure sensitive, mechanically-actuated seismic safety valve, conforming to ASME A17.1, Rule 3.19.4.7. Connect valve directly to jack assembly inlet.
2. Provide Shut-Off Valve, manual ball-type valve on-line adjacent to pump unit.
3. Provide easily accessible Overspeed Rupture Valve inside the hoistway elevator pit.

H. Terminal Stopping: Provide normal and final devices.

I. Electrical Wiring and Wiring Connections:
1. Conductors and Connections: Copper throughout with individual wires coded and connections on identified studs or terminal blocks. Use no splices or similar connections in wiring except at terminal blocks, control compartments, or junction boxes. Provide 10% spare conductors throughout. Run spare wires from car connection points to individual elevator controllers in the machine room.
2. Conduit: Galvanized steel conduit, EMT, or duct. Flexible conduit length not to exceed 3'-0". Flexible heavy-duty service cord may be used between fixed car wiring and car door switches for door protective devices. Conduit from the closest hoistway of each elevator group or single elevator to the firefighters' control room.
3. Traveling Cables: Flame and moisture-resistant outer cover. Prevent traveling cable from rubbing or chafing against hoistway or equipment within hoistway.
   a. Provide two RG-6/U coaxial CCTV cable and four pair of shielded 18 gauge wire within traveling cable from car controller to car top junction box, plus 3'-0" excess loop at both ends.
   b. Provide two pair of 18 gauge wire for CCTV power.
   c. Provide four pair of spare shielded communication wires in addition to those required to connect specified items.
   d. Tag spares in machine room. Provide cables from controller to car top.
4. Auxiliary Wiring: Provide conduit, wiring and connections for fire alarm initiating devices, emergency two-way communication system, paging speaker, CCTV, digital video display, security system, intercom, and announcement speaker and/or background music from the machine room junction box to each car controller in machine room.

J. Floor Numbers: Stencil paint 4" high floor designations in contrasting color on inside face of hoistway doors or hoistway fascia in location visible from within car.

2.8 HOISTWAY ENTRANCES

A. Complete entrances bearing fire labels from a nationally recognized testing laboratory approved within the governing jurisdiction.

B. Frames: 14 gauge hollow metal at all floors. Mitered and welded head to jamb assembly at all floors. Clad frames with finish material indicated in finish schedule at all floors. Provide Arabic floor designation/Braille plates, centered at 60" above finished floor, on both side jambs of all entrances. Provide plates at main egress landing with "Star" designation. Provide "Star of Life" designation plates at height of 78"-84" above finished floor on both side jambs at all floors. Braille indications shall be below Arabic floor designation. Provide cast floor designation/Braille plates as manufactured by SCS Elevator Products, Inc. or Vision Mark. Provide 14 gauge subframe for special architectural overlay finishes at all floors. Size clear opening of subframes at least 4" wider and 2" higher than clear finish opening.

C. Door Panels: Stainless steel with Glass Panels. Provide leading edges of center-opening doors with rubber astragals. Provide a minimum of two gibs per panel, one at leading and one at trailing edge with gibs in the sill groove entire length of door travel. Construct door panels with interlocking, stiffening ribs. Architectural metal cladding shall wrap around leading and trailing edge of panel and return a minimum of 1/2" on rear side of leading edge of panel at all floors. Provide safety retainers as required by Rule 2.11.11.8 of ASME A17.1.The top and bottom of horizontally sliding doors shall be provided with a means of retaining the door panels in

position if the primary guiding means fail, and shall prevent displacement of the door panel (top and bottom) by not more than three fourths of an inch into the hoistway.

D. Entrance Equipment:
1. Door Hangers: Two-point hanger roller with neoprene roller surface and suspension with eccentric upthrust roller adjustment.
2. Door Tracks: Bar or formed, cold-drawn removable steel tracks with smooth roller contact surface.
3. Door Interlocks: Operable without retiring cam. Paint interlock box flat black.
4. Door Closers: Spring, spirator, or jamb/strut mounted counterweight type. Design and adjust to insure smooth, quiet mechanical close of doors.
5. Hoistway Door Unlocking Device: Provide unlocking device with escutcheon in door panel at all floors, with finish to match adjacent surface.

E. Sight Guards: 14 gauge, same material and finish as hoistway entrance door panels. Construct without sharp edges

F. Hoistway Access Switches: Mount in entrance frame side jamb at top and bottom floors. Provide switch with faceplate

G. Sills: Nickel Silver.

H. Sill Supports: Structural or formed steel designed to support door sill based upon car loading classification. Mount to eliminate need for grout under the sill.

I. Toe Guards and Hanger Covers: 14 gauge furniture steel with black enamel finish. Provide toe guards, and hanger covers. Provide car door interlock to prevent opening of car doors outside the unlocking zone.

J. Struts and Headers: Provide for vertical support of entrances and related material. Provide door open bumpers on entrances equipped with vertical struts.

K. Finish of Frames and Doors: Provide welded entrance frames with # 4 finish stainless steel finish.

L. Hoistway Access:
1. Hoistway Door Unlocking Device: Provide unlocking device with locking escutcheon collar in door panel at all floors, with finish to match adjacent surface.
2. Hoistway Access Switches: Mount in entrance frame side jamb at all terminal landings. Provide switch with approved faceplate.

2.9 CAR EQUIPMENT

A. Frame: Welded or bolted, rolled or formed steel channel construction to meet load classification specified.

B. Platform: Isolated type, constructed of steel, or steel and wood which is fireproofed on underside. Design and construct to accommodate load classification requirements. Provide Class “A” construction for passenger elevators. Provide recess to accommodate a minimum 1" floor thickness.

C. Platform Apron: Minimum 14 gauge steel, reinforced and braced to car platform, front and rear with black enamel finish.

D. Guide Shoes: Roller type with three or more spring dampened, sound-deadening rollers per shoe. Maximum roller rotation speed, 350 rpm. Solid type.

E. Finish Floor Covering: Provided:
1. Rubber tile 1/8" thick with 1" diameter by 0.025 high, raised circular pattern. Color selected by Architect.

F. Sills: One piece extrusion with extruded extension between car entrance columns to face of car front return. Extruded extension to match finish of sill.
1. Stainless steel.

G. Door Hangers: Two-point hanger roller with neoprene roller surface and suspension with eccentric upthrust roller adjustment.

H. Door Track: Bar or formed, cold-drawn removable steel track with smooth roller contact surface.

I. Door Header: Construct of minimum 12 gauge steel, shape to provide stiffening flanges.

J. Door Electrical Contact: Prohibit car operation unless car door is closed. Provide car door interlock to prevent opening of car doors outside the unlocking zone.

K. Door Clutch: Heavy-duty clutch, linkage arms, drive blocks and pickup rollers or cams to provide positive, smooth, quiet door operation. Design clutch so car doors can be closed, while hoistway doors remain open.

L. Restricted Opening Device: Provide car-door interlock to prevent opening of car doors outside unlocking zone.

M. Door Operator: High-speed, heavy-duty door operator capable of opening doors at no less than 2.5 fps. Accomplish reversal in no more than 2½" of door movement. Provide solid-state door control with closed loop circuitry to constantly monitor and automatically adjust door operation based upon velocity, position, and motor current. Provide a minimum of four controller-activated motion profiles, per floor, per door, to maintain consistent, smooth, and quiet door operation at all floors, regardless of door weight or varying air pressure. Acceptable closed-loop door operators:
1. KONE: AMD 2.0
2. Otis: AT 400 - i Motion II (Optional)
3. Thyssenkrupp: HD91 StarTrac
4. G.A.L.: MOVFR

N. Door Control Device:
1. Infrared Reopening Device:
a. Black, fully enclosed device with full screen infrared matrix or multiple beams extending vertically along leading edge of each door panel to minimum height of 7'-0" above finished floor. Provide additional beams full height of door panels. Device shall prevent doors from closing and reverse doors at normal opening speed if beams are obstructed while doors are closing, except during nudging operation.

In event of device failure, provide for automatic shutdown of car at floor level with doors open:

b. Acceptable Infrared Reopening Device:
   1) Cegard/MAX-154 by CEDES
   2) Gatekeeper by Adams
   3) Magic Edge by Tri-Tronics
   4) Microlite by thyssenkrupp
   5) Microscan E by T.L. Jones
   6) Pana40 Plus by Janus

2. Nudging Operation: After beams of door control device are obstructed for a predetermined time interval (minimum 20.0-25.0 seconds), warning signal shall sound and doors shall attempt to close with a maximum of 2.5 foot pounds kinetic energy. Activation of the door open button shall override nudging operation and reopen doors.
3. Interrupted Beam Time: When beams are interrupted during initial door opening, hold door open a minimum of 3.0 seconds. When beams are interrupted after the initial 3.0 second hold open time, reduce time doors remain open to an adjustable time of approximately 1.0-1.5 seconds after beams are reestablished.
4. Differential Door Time: Provide separately adjustable timers to vary time that doors remain open after stopping in response to calls.
   a. Car Call: Hold open time adjustable between 3.0 and 5.0 seconds.
   b. Hall Call: Hold open time adjustable between 5.0 and 8.0 seconds. Use hall call time when car responds to coincidental calls.

O. Car Operating Panel:
1. Passenger: Two car operating panels with faceplates consisting of a metal box containing the vandal resistant operating fixtures, mounted behind the car stationary front return panel.
   a. Provide manually operated stop switch within Firefighters' Phase II compartment Arrange switch to sound group control panel distress signal when actuated.
   b. Provide "door open" button to stop and reopen doors or hold doors in open position.
   c. Provide "door close" button to activate door close cycle. Cycle shall not begin until normal do
2. Suitably identify floor buttons, alarm button, door open button, door close button, and emergency push-to-call button with approved cast tactile symbols recessed flush mounted fastenings. Configure plates per local building code accessibility standards including Braille. Locate top floor button at maximum height allowed above the car floor; no lower than 35" for emergency push-to-call button and alarm button.
3. Provide minimum 3/4" diameter raised floor pushbuttons that illuminate to indicate call registration.
4. Provide alarm button to ring bell located on car, and sound distress signal at group control panel. Illuminate button when actuated.
5. Provide Firefighters' devices and operation. Install firefighters' telephone jack with approved mounting in firefighter's compartment.
6. Provide lockable service compartment with recessed flush door. Door material and finish shall match car return panel or car operating panel faceplate. Inside surface of door shall contain an integral flush window for displaying the elevator operating permit. Include the following controls in lockable service cabinet with function and operating positions identified by permanent signage or engraved legend:
   a. Inspection switch.
   b. Light switch.

c. Exhaust blower switch.
d. Independent service switch.
e. Constant pressure test button for battery pack emergency lighting.
f. 120-volt, AC, GFCI protected electrical convenience duplex outlet.
g. Keyed stop switch.

7. Provide black paint filled (except as noted), engraved, or approved etched signage as follows with approved size and font:
   a. Phase II firefighters' operating instructions on inside face of firefighters' compartment door. Engrave filled red firefighters' operation on outside face of compartment door.
   b. Building identification car number on main and auxiliary car operating panels.
   c. "No Smoking" on main and auxiliary car operating panels.
   d. Car capacity in pounds on main car operating panel.
   e. Loading classification and description on car operating panel.

P. Car Top Control Station: Mount to provide safe access and utilization while standing in an upright position on car top.

Q. Work Light and Duplex Plug Receptacle: GFCI protected outlet at top of car. Include on/off switch and lamp guard. Provide additional GFCI protected outlet on car top for installation of car CCTV.

R. Communication System:
1. Two-way communication instrument in car with automatic dialing, tracking, and recall features, with shielded wiring to car controller in machine room. Provide dialer with automatic rollover capability with minimum two numbers.
   a. Actuate two-way communication via "Help" button.
   b. Button or adjacent light jewel shall illuminate and flash when call is acknowledged.
   c. Button shall match car operating panel pushbutton design.
   d. Provide "Help" button tactile symbol, engraved signage, and Braille adjacent to button mounted integral with car front return panel.
2. Firefighters' communication jack in car and firefighters' panel jack bezel shall match adjacent controls.
3. Install remote speaker(s) provided under Item 1.01. E.1 in car behind front return panel with drilled speaker pattern, with shielded wiring to machine room junction box.
4. Provide two-way communication between car and machine room if required.

2.10 CAR ENCLOSURE

A. Passenger Elevator: Provide complete as specified herein and detailed on architectural drawings.
1. Canopy: Reinforced 12 gauge furniture steel formed panels with lockable, contacted, hinged emergency exit. Interior finish white color reflective baked enamel.
2. Front and Rear Return Panels: Reinforced 14 gauge furniture steel clad with minimum 16 gauge satin finish stainless steel with cutouts for applied car operating panel(s) and other equipment.
3. Transom: Reinforced 14 gauge furniture steel clad with minimum 16 gauge satin finish stainless steel full width of enclosure with cutout for car position indicator.
4. Car Door Panels: Reinforced minimum 16 gauge furniture steel clad with minimum 18 gauge satin finish stainless steel with Glass Panels. Same construction as hoistway door

panels. Cladding shall wrap leading and trailing edge of panel a minimum of 1/2" on rear side.

5. Base: Satin finish stainless steel.
6. Interior Wall Finish: Stainless Steel with Glass Panels as specified by the Architect, and in conformance with ANSI Z.97.1.
7. Ventilation: Morrison Products, Inc. three-speed model SOE No. 06-01055 exhaust blower mounted to car canopy on isolated rubber grommets. Exhaust blower shall meet noise and vibration criteria.
8. Lighting: Provide LED fixtures with wiring and hookup. Coordinate with emergency lighting requirements
9. Suspended Ceiling: Coordinate with Architectural Drawings.
10. Handrails: Minimum 1¼" diameter stainless steel tubular grab bar with backing plates and captive nuts across side walls. Special design included in allowance in Interior Wall Finish item above. Bolt rails through car walls from back and mount on 1½" deep solid round stainless steel standoff spacers no more than 18" O.C. Return handrail/guardrail ends to car walls.
11. Pads and Hooks for the Car. Three-piece removable pads. Two pads covering side walls and adjacent front returns and one covering rear wall. Provide cutouts to access main car operating panel.
12. Cab Air Conditioner/Heater Unit: Provide self-contained cab air conditioner/heater on car top with concealed ducts, thermostat control, and evaporator. Isolate from car top to comply with noise and vibration requirements.

2.11 HALL CONTROL STATIONS

A. Pushbuttons: Provide one riser with flush mounted faceplates. Include pushbuttons for each direction of travel that illuminate to indicate call registration. Pushbutton design shall match car operating panel pushbuttons. Single riser at typical floors. Provide vandal resistant pushbutton and light assemblies. Provide LED illumination.

B. Phase I Fire Service fixture, including keyswitch, engraved operating instructions and illuminating jewel.

2.12 SIGNALS

A. Car Direction Lantern:
1. Provide flush-mounted car lantern in all car entrance columns .
2. Illuminate up or down LED lights and sound tone once for up and twice for down direction prior to car arrival at floor. Illuminate light until the car doors start to close.
3. Sound level shall be adjustable from 20-80 dBA measured at 5'-0" in front of hall control station and 3'-0" off floor.
4. Provide adjustable car door dwell time to comply with ADA requirements relative to hall call notification time.
5. Provide vandal resistant lantern and light assemblies consisting of series of dots or lines for maximum visibility.

B. Car Position Indicator:

1. In addition to position and direction, the display shall interface with the elevator control system to provide system-based messages for the following conditions at a minimum:
   a. Firefighters' Service, Phase I

b. Independent Service
c. Car-to-Lobby Activated

C. Faceplate Material and Finish: Satin finish stainless steel, all fixtures. Tamper resistant fasteners for all fastenings exposed to the public.
1. Car Direction Lantern
2. Car Position Indicator
3. Hoistway Access Switch
4. Phase I Keyswitch Faceplate

D. Floor Passing Tone: Provide an audible tone of no less than 20 decibels and frequency of no higher than 1500 Hz, to sound as the car passes or stops at a floor served.

E. Firefighters' Control Panel: Locate in building fire control room. Fixture faceplate, stainless steel satin finish, including the following features:
1. Car position and direction indicator (digital-readout or color SVGA display type). Identify each position indicator with car number.
2. Indicator showing operating status of car.
3. Manual car standby power selection switches and power status indicators.
4. Two-position firefighters' emergency return switches and indicators with engraved instructions filled red.
5. Firefighters' telephone jack.
6. Fixtures and monitor shall be located as directed by Architect. Where applicable, identify all indicators and manual switches with appropriate engraving. Provide conduit and wiring to control panel. Coordinate size and location with Building Console Supplier.

F. Firefighters' Key Box: Flush-mounted box with lockable hinged cover. Engrave instructions for use on cover per Local Fire Authority requirements.

1. System Performance Monitoring:
a. Hall call registration information: Provide memory capacity for at least the preceding five, 24-hour periods, in blocks of 5- or 15-minute segments, running hour to hour (i.e., 2:00 p.m. to 3:00 p.m.)
1) Visual and printed summary of hall call registration events by floor, direction, and duration, totaled in 5- or 15-minute segments during any 60-minute block using an internal clock.
2) Visual and printed summary of hall call registration duration averaged for 5- or 15-minute and hourly periods.
3) Visual and printed summary of percentage of hall calls answered within 30 and 60 seconds in each 5- or 15-minute and hourly periods.
4) Visual and printed summary of time periods during which individual cars are not in group operation (operating separately or out of service).
b. Accumulate system fault data including nature of fault, time, and day. Store and retrieval capabilities for minimum 30-day period.
2. Provide printer to produce a hard copy of stored data. Provide directions and software to accomplish information retrieval.

2.13 INTERCOM AND DISTRESS SIGNAL SYSTEM

A. General: Provide intercommunication system for Car. Include all wiring between elevator hoistways and control panels. Include the following stations:

Station Location	Type Station	Selection Buttons to Call
Elevator Machine Room	Master	Control Panel
Lobby Control Panel	Master	Machine Room
Firefighters' Control Panel	Master	Machine Room
Elevator	Remote	Liftnet Monitoring Station

B. Basic Equipment:
1. Amplifier providing static-free voice transmission with adequate volume and minimum distortion at all stations, with pre-amplifier capable of receiving voice and music inputs from building and emergency building communication system.
2. Activation of emergency building communication system overrides all other conversations and permits one-way conversation to all master stations in system.
3. Master Stations:
   a. Speaker-microphone combination and/or handset for two-way communication.
   b. Selection buttons to enable communication with all master stations. Maintain continual reception of hands-free reply from station when a selected button is depressed.
   c. Two-Position "Talk/Listen" Button: Press to talk; release to listen.
   d. Illuminate "in use" light when any master station is being used.
   e. Reset button to make system available for use by any master station.
   f. Volume control knob for adjustment of incoming volume.
   g. Button to establish communications with all stations.
   h. Distress light in lobby panel which illuminates when "push to call" button or alarm button in car is actuated. Energize distress light and buzzer or chime until intercom selection button for that car has been depressed. Sound buzzer or chime in lobby panel simultaneously with illumination of distress light.
4. Remote Stations:
   a. Station in car shall be activated by "push to call," two-way communication button. "Push to call" button shall illuminate and flash when call is acknowledged. Button shall match car operating panel pushbutton design. Provide uppercase "PUSH TO CALL," "HELP ON THE WAY" engraved signage adjacent to button. Provide "push to call" button tactile symbol, engraved signage, and Braille adjacent to button.
   b. Locate car microphone and speaker, or transceiver/speaker combination behind front return panel.

C. Station Housings:
1. House master station in machine room in a metal compartment with baked enamel finish. Attach to the group elevator supervisory control panel or wall mount. Provide communication handset with 25'-0" long cord.
2. Provide control center master intercoms with stainless steel satin finish faceplates and engraved operating instructions. Coordinate faceplate size and installation of units with building Console Supplier.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to beginning installation of equipment examine hoistway and machine room areas. Verify no irregularities exist which affect execution of work specified.

B. Do not proceed with installation until work in place conforms to project requirements.

3.2 INSTALLATION

A. Install all equipment in accordance with Contractor's instructions, referenced codes, specification, and approved submittals.

B. Install machine room equipment with clearances in accordance with referenced codes and specification.

C. Install all equipment so it may be easily removed for maintenance and repair.

D. Install all equipment for ease of maintenance.

E. Install all equipment to afford maximum accessibility, safety, and continuity of operation.

F. Remove oil, grease, scale, and other foreign matter from the following equipment and apply one coat of field-applied machinery enamel.
   1. All exposed equipment and metal work installed as part of this work which does not have architectural finish.
   2. Machine room equipment, hoistway equipment including guide rails, guide rail brackets, and pit equipment.
   3. Neatly touch up damaged factory-painted surfaces with original paint color. Protect machine-finish surfaces against corrosion.

G. Clean all architectural finishes and replace or restore any surfaces damaged during construction to like new condition.

H. Final payment, for retainage of 10%, shall not be made for the installation work prior to the conclusion of the Warranty / Maintenance period.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Operating Test: Load elevator to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.

C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 ADJUSTING

A. Install hydraulic jack assembly and guide rails plumb and align vertically with tolerance of 1/16" in 100'-0". Secure guide rail joints without gaps and file any irregularities to a smooth surface.

B. Lubricate all equipment in accordance with Contractor's instructions.

C. Adjust motors, valves, controllers, leveling switches, limit switches, stopping switches, door operators, interlocks, and safety devices to achieve required performance levels.

3.5 CLEANUP

A. Keep work areas orderly and free from debris during progress of project. Remove packaging materials on a daily basis.

B. Remove all loose materials and filings resulting from work.

C. Clean machine room equipment and floor.

D. Clean pit equipment and floor.

E. Clean hoistways, car, car enclosure, entrances, operating, and signal fixtures.

3.6 TEST RESULTS:

A. Under any load obtain specified contract speed, performance times, stopping accuracy without re-leveling, and ride quality to satisfaction of Consultant. Tests may be conducted under no load, balanced load, and full load conditions.

B. Consultant may test temperature rise in motor windings limited to 50° Celsius above ambient. A full-capacity one hour running test, stopping at each floor for ten seconds in up and down directions, may be required.

C. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevators.

D. Check operation of each elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.
   1. Engage Elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items which cannot be refinished in the field to the shop, make required repairs, and refinish entire unit, or provide new units as required.

END OF SECTION

SECTION 26 05 33.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Requirements for furnishing, installing, energizing, and testing conduit, tubing, and fittings for communication lines and electrical transmission, distribution, and service lines.

B. Related Section:
1. Section 01 33 00 - Submittal Procedures.
2. Section 07 84 00 - Firestopping.
3. Section 26 05 00 - Common Work Results for Electrical
4. Section 26 05 26 - Grounding and Bonding.
5. Section 26 05 28 - Hangers and Supports for Electrical Systems.
6. Section 26 05 63 – Acceptance Testing for Electrical Systems.

1.2 REFERENCES

A. American National Standards Institute (ANSI):
1. ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
2. ANSI C80.1 - Rigid Steel Conduit - Zinc-Coated (GCR).

B. American Society for Testing and Materials (ASTM):
1. ASTM A 568/A 568M - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold Rolled, General Requirements for.
2. ASTM D 1784 - Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

C. National Electric Manufacturer's Association (NEMA):
1. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
2. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.

D. National Fire Protection Association (NFPA):
1. NFPA 70 - National Electrical Code (NEC).

E. Underwriters Laboratory, Inc. (UL):
1. ANSI/UL 6 - Standard for Rigid Metal Conduit.
2. ANSI/UL 360 - Standard for Liquid-Tight Flexible Steel Conduit.
3. ANSI/UL 498 - Standard for Safety for Attachment Plugs and Receptacles.
4. ANSI/UL 514A - Metallic Outlet Boxes.
5. ANSI/UL 886 - Standard for Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

F. Institute of Electrical and Electronics Engineers (IEEE):
1. IEEE C2 - National Electrical Safety Code.

1.3 DEFINITIONS

A. Definitions for all items are as stated in NFPA 70, IEEE C2, and in other reference documents unless otherwise stated, specified, or noted.

1.4 DESIGN REQUIREMENTS

A. Conduit Systems:
   1. Provide conduit of the type and material shown in **Table 26 05 33.13-1, 26 05 33.13-3 and 26 05 33.13-4** for the application indicated, or as indicated on the Contract Drawings.
   2. Provide conduit fittings made of material identical to that of the conduit system with which they are used.

Table 26 05 33.13-1 Conduit System Selection

Location	Condition 1	Condition 2	Conduit Type	Size (Minimum) 1
Under-Ground	Encased	Bends, over 10 degrees in length	~~Fiberglass Conduit~~ RGS Conduit	1 Inch
		Conduit Risers	~~Fiberglass Conduit~~ RGS Conduit	1 Inch
		Exposed conduit within 6-inches of exit from encasement	PVC Coated Rigid Galvanized Steel	1 Inch
		Straight Runs	~~Fiberglass~~ RGS	1 Inch

1 No conduit smaller than 1-inch trade size is permitted unless indicated otherwise on the Contract Drawings.

Table 26 05 33.13-3 Conduit System Selection				
Location	**Condition 1**	**Condition 2**	**Conduit Type**	**Size (Minimum)** [1]
Above-Ground	Outside	NEMA 3R/4/4X locations	PVC Coated Rigid Galvanized Steel	3/4 Inch
	Inside NEMA 1/12	Within 6-inches of floor when exposed	PVC Coated Rigid Galvanized Steel	3/4 Inch
		Within 6-inches of floor when within footprint of floor mounted equipment	PVC Coated Rigid Galvanized Steel	3/4 Inch
		Above suspended ceilings	Rigid Galvanized Steel	3/4 Inch
		Concealed in Open-Cell Masonry Block Wall	Rigid Galvanized Steel	3/4 Inch
		Concealed in Cast-in-Place Concrete Wall or Floor	Rigid Galvanized Steel	3/4 Inch
		Concealed behind Gypsum Board Wall or Ceiling	Rigid Galvanized Steel	3/4 Inch

Table 26 05 33.13-3 Conduit System Selection				
Location	**Condition 1**	**Condition 2**	**Conduit Type**	**Size (Minimum) 1**
1 No conduit smaller than 3/4-inch trade size is permitted unless indicated otherwise on the Contract Drawings.				

Table 26 05 33.13-4 Conduit System Selection				
Location	**Condition 1**	**Condition 2**	**Conduit Type**	**Size (Minimum) 1**
Above-Ground	Inside NEMA 3R/4/4X	Within 6-inches of floor	PVC Coated Rigid Galvanized Steel	3/4 Inch
		Concealed in Masonry Block Wall	Rigid Galvanized Steel,	
		Concealed in Cast-in-Place Concrete Wall or Floor	Rigid Galvanized Steel	3/4 Inch
		Recess Mounted Lighting Fixtures and Rotating or Vibrating Equipment	Liquid-Tight Flexible Metal Conduit	3/4 Inch
		Exposed	PVC Coated Rigid Galvanized Steel	3/4 Inch
		Recess Mounted Lighting Fixtures and Rotating or Vibrating Equipment	Liquid-Tight Flexible Metal Conduit	3/4 Inch
1 No conduit smaller than 3/4-inch trade size is permitted unless indicated otherwise on the Contract Drawings.				

1.5 SUBMITTALS

A. Submit the following information to Metro North Railroad for approval in accordance with the requirements of Section 01 33 00, Submittal Procedures:
   1. Product Data:
      a. To facilitate power utility approval of the items installed from the utility's service poles to the main service panels, submit 4 more copies of the conduit submittals than the number required by Section 01 33 00, Submittal Procedures.
      ~~b. Fiberglass Conduit~~
      c. Plastic coated rigid galvanized steel conduit.
      d. Liquidtite flexible metal conduit.
      e. Rigid galvanized steel conduit (RGS).
      f. Fittings for metallic conduit systems.
      g. Conduit spacers.
      h. Heat shrink tubing.
      i. Wall and floor penetration seals.
      j. Cold galvanize coating.
   2. Shop Drawings:
      a. Proposed departures from the original design.
   3. Quality Assurance/Control Submittals:
      a. Qualification Statements:
         1) Qualifications of the installer.
         2) Qualifications of the Electrical Testing Laboratory (ETL).
      b. Certificates:
         1) Testing agency/quality verification, listing, and labeling.

1.6 QUALITY ASSURANCE

A. Qualifications:
   1. Installer Qualifications:
      a. Employ an installation firm with a minimum of three years documented experience installing conduit and tubing similar in type and scope to that required by this Contract to install the Work of this Section.
      b. Employ skilled licensed electricians to supervise the Work of this Section.
      c. Submit information verifying the installer's qualifications.
   2. Electrical Testing Laboratory (ETL) Qualifications:
      a. Employ an independent testing agency, qualified as specified in Section 26 05 63, Acceptance Testing for Electrical Systems, to perform the testing required by this Section.
      b. Submit information verifying the ETL's qualifications.

B. Regulatory Requirements:
   1. Perform the Work of this Section in accordance with the requirements specified in NFPA 70 (NEC), and to other applicable state, local, and national governing codes and regulatory requirements.
   2. All items installed from utility service poles to the main service panels must be approved by the serving utility, whether electrical service or telephone service, as listed in Section 26 05 00, Basic Electrical Materials and Methods.

C. Certifications:
1. Provide products that are listed and labeled by Underwriters Laboratory, approved by Factory Mutual, or certified as meeting the standards of UL by the Electrical Testing Laboratory (ETL) for the location the product is installed in, and the application intended, unless products meeting the requirements of these nationally recognized testing laboratories are not available or unless standards do not exist for the products.
a. Submit evidence with the Product Data that the products represented meet testing agency quality verification requirements, including agency listing and labeling requirements.
1) Such evidence may consist of either a printed mark on the data or a separate listing card.
b. Submit a written statement from those product manufacturers that do not provide evidence of the quality of their products that indicates why an item does not have a quality assurance verification.
1) Such statements provided in lieu of quality assurance verification are subject to the acceptance of Metro North Railroad.

1.7 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
1. Pack, ship, handle, and unload products in accordance with the requirements of Section 26 05 00, Basic Electrical Materials and Methods, and as detailed herein.

B. Acceptance at Site:
1. Acceptance products at the Site in accordance with the requirements of Section 26 05 00, Basic Electrical Materials and Methods, and as detailed herein.

C. Storage and Protection:
1. Store products in accordance with the requirements of Section 26 05 00, Basic Electrical Materials and Methods, and as detailed herein.
a. Store all products indoors on blocking or pallets.

PART 2 - PRODUCTS

2.1 NON-METALLIC CONDUIT – NOT USED

~~Fiberglass Reinforced Epoxy (FRE) Electrical Conduit and Fittings~~

~~2.2 Non-metallic conduit and conduit fittings shall be as follows:~~

A. ~~Conduit and fittings shall be inside diameter based unless otherwise specified.~~

B. ~~Conduits and fittings encased in concrete shall have a minimum wall thickness of 0.070 inch for up to 4 inch diameter conduits and 0.096 inch for conduits larger than 4 inch diameter unless otherwise specified.~~

C. ~~Conduits emerging from concrete encasement and those installed aboveground shall have a wall thickness of not less than 0.25 inch.~~

D. ~~Conduit and fittings shall be manufactured by Champion Fiberglass, or approved equal.~~

E. ~~Metallic ties shall not be used when constructing embedded conduit system. Concrete encased conduits shall be assembled utilizing plastic base and intermediate spacers to provide the minimum required clear spacing between centerlines of parallel conduits.~~

~~2.3 Furnish UL listed material in accordance with NEC for underground use.~~

~~2.4 Furnish material that has the following minimum properties:~~

A. ~~Exposed ducts shall conform to NEMA TC-14A.~~

B. ~~Tensile Strength: The minimum longitudinal tensile strength of the duct shall not be less than 9,000 psi when tested in accordance with ASTM D2105.~~

C. ~~Dielectric Strength: The minimum dielectric strength shall be 500 volts/mil when tested in accordance with ASTM D149~~

D. ~~Heat Distortion: The minimum heat distortion temperature shall be 215 degrees Fahrenheit when tested at 264 psi in accordance with ASTM D648.~~

E. ~~Fire Resistance: FRE duct and fittings shall exceed the standards of UL 651, which requires that vertical specimens shall self extinguish within five seconds after any of three successive 60 second flame applications.~~

F. ~~Flame Spread: Surface flammability of conduit and fittings shall not exceed a maximum index rating of 30 when tested under radiant heat in accordance with ASTM E162.~~

G. ~~Smoke Density: The specific optical density of smoke generated by solid materials in the duct and fittings (in either the flaming or non flaming mode), shall not exceed 25 within four minutes after start of test, in accordance with ASTM E662.~~

H. ~~Toxicity: Smoke toxicity shall not exceed the following values in parts per million (ppm):~~

~~Gases~~	~~Values (max. ppm)~~
~~Hydrogen Chloride~~	~~0~~
~~Hydrogen Bromide~~	~~0~~
~~Hydrogen Cyanide~~	~~<1~~
~~Hydrogen Sulfide~~	~~0~~
~~Ammonia~~	~~0~~
~~Aldehydes as HCHO~~	~~<10~~
~~Oxides of Nitrogen~~	~~<50~~
~~Carbon Dioxide~~	~~<12,500~~
~~Carbon Monoxide~~	~~<250~~

~~2.5 Elbows and fittings shall be manufactured from the same resin/hardener/glass systems and by the same filament wound system as the conduit unless noted otherwise~~

2.6 METALLIC CONDUIT

A. Plastic Coated Rigid Galvanized Steel Conduit:
   1. Provide plastic coated rigid galvanized steel conduit bearing the UL label.
   2. Provide base conduit of rigid hot-dip galvanized steel conduit as specified in Paragraph2.6.C , and of the type indicated, specified, or scheduled to be coated.
   3. Apply plastic coating in accordance with the following:
      a. Apply a 40-mil thick PVC coating on the outside and a 2-mil thick fusion- bonded blue, red, or green urethane coating on the inside, both coatings conforming to the requirements of NEMA RN 1.
      b. Have the same manufacturer who produces the hot dip galvanized base conduit factory-apply the plastic coating.
      c. Provide plastic coating of one uniform color on all plastic coated rigid galvanized steel conduit provided for the Contract.
   4. Provide 40-mil thick plastic sleeves to protect internally threaded conduit openings.
      a. Provide sleeves with an inside diameter equal to the outside diameter of the conduit/pipe protected by it; and extending either one pipe diameter or 2- inches, whichever is less, beyond the opening.
   5. Manufacturers:
      a. OCAL, http://www.tnb.com/Design Builder/docs/ocal.pdf.
      b. Robroy Industries/Perma-Cote, www.permacote.com.

B. Liquidtite Flexible Metal Conduit:
   1. Provide PVC coated flexible metal conduit conforming to the requirements of Article 350 of NFPA 70 (NEC) for materials and uses and ANSI/UL 360.
   2. Provide conduit with interlocking spiral strip construction capable of bending to a minimum radius of five times its diameter without deforming the spiral strips both inside and outside of the conduit.

a. Provide conduit with a flexible, galvanized, interlocking spiral strip steel core jacketed with smooth, liquid-tight polyvinyl chloride designed to withstand temperatures from minus 40 degrees Celsius to plus 60 degrees Celsius.

3. Finish the interior and exterior of flexible conduit smooth and free from burrs, sharp edges, and other defects that may injure wires; and place the manufacturer's trademark on each length.
4. Furnish an integral continuous copper ground in 1/2-inch through 1-1/4-inch PVC coated flexible metal conduit.
5. Acceptable Manufacturers
   a. Electri-Flex Company, Liquatite®, Type LA, www.electriflex.com.
   b. ANAMET Electrical, Inc., Anaconda Sealtite®, www.anacondasealtite.com.
   c. Or Approved Equal.

C. Rigid Galvanized Steel Conduit (RGS):
1. Provide rigid galvanized steel conduit (RGS) conforming to the requirements of Article 344 of NFPA 70 (NEC) for materials and uses, ANSI C80.1, and UL 6.
2. Fabricate the RGS from mild steel piping, galvanized or sherardized inside and outside, and protected against corrosion by a dichromate rinse or a zinc chromate coating.
3. Provide defect free conduit bearing the UL label, and furnished in 10-foot minimum lengths with both ends threaded and one end fitted with a coupling.
   a. Provide tapered NTP 3/4 inch per foot threads complying with ANSI/ASME B1.20.1.
4. Acceptable Manufacturers:
   a. Tyco/Allied Tube and Conduit, www.alliedtube.com.
   b. Wheatland Tube Company, Division of John Maneely Company, www.wheatland.com.
   c. Approved equal.

2.7 CONDUIT FITTINGS

A. Fittings for Metallic Conduit Systems:
1. Construct conduit bodies/fittings from cast malleable iron or cast steel.
2. For PVC coated raceway systems, provide PVC coated fittings of cast malleable iron or cast steel from the same manufacturer that provides the uncoated conduit bodies/fittings.
3. For RAC raceway systems, provide RAC fittings of aluminum from the same manufacturer that provides the uncoated conduit bodies/fittings. Provide hazardous Class 1, Division 1, Group C & D for NEMA 7 locations.
4. Conduit Outlet Bodies:
   a. Provide malleable iron threaded entry type conduit outlet bodies with neoprene gaskets and cast steel conduit.
   b. Acceptable Manufacturers:
      1) EGS/Appleton Electric, www.appletonelec.com.
      2) EGS/O-Z/Gedney, www.o-zgedney.com.
      3) Or Approved Equal.
5. Conduit Expansion Joints:
   a. Provide telescoping sleeve type galvanized, weatherproof, and vapor tight conduit expansion joints designed for 4-inch maximum expansion with an insulated bushing and lead-wool packing.
   b. Acceptable Manufacturers:
      1) EGS/Appleton Electric, www.appletonelec.com.

2) EGS/O-Z/Gedney, www.o-zgedney.com.
3) Or Approved Equal.

6. Conduit Unions:
   a. Provide conduit unions capable of completing a conduit run when neither conduit end can be turned.
   b. Acceptable Manufacturers:
      1) EGS/Appleton Electric, UNF and UNY Unions, www.appletonelec.com..
      2) Thomas and Betts Company, Erickson® Coupling., www.tnb.com/Design Builder/docs/tbhazardous.pdf
      3) Or Approved Equal.
7. Conduit Outlet Boxes:
   a. Provide malleable or cast iron conduit outlet boxes conforming to the requirements of UL 886, and having a cover with O-rings to keep out moisture.
   b. Acceptable Manufacturers:
      1) EGS/Appleton Electric, GRF outlets and covers, www.appletonelec.com.
      2) EGS/O-Z Gedney, www.o-zgedney.com.
      3) Or Approved Equal.
8. Conduit Device Boxes:
   a. Provide malleable iron conduit device boxes with internal grounding screws and conforming to the requirements of UL 498 and UL 514A.
   b. Acceptable Manufacturers:
      1) EGS/Appleton Electric, FD device boxes, www.appletonelec.com.
      2) EGS/O-Z Gedney, www.o-zgedney.com.
      3) Or Approved Equal.
9. Conduit Sealing Fittings:
   a. Provide, triple coated, malleable iron conduit sealing fittings.
      1) Coat the conduit sealing fittings with zinc electroplate, dichromate, and an epoxy powder coat.
   b. Provide drain fittings in conduit sealing fittings where required.
   c. Provide sealing covers for junction boxes where required.
   d. Acceptable Manufacturers:
      1) EGS/Appleton Electric, www.appletonelec.com.
         a) Sealing hubs: ES.
         b) Sealing fittings: EYSEF, EYSDEF, and EYD.
      2) EGS/O-Z Gedney, www.o-zgedney.com.
      3) Or Approved Equal.

2.8 CONDUIT SPACERS

A. Provide non-metallic, interlocking type conduit spacers which snap together to join any combination of intermediate and base units together, both vertically and horizontally.

B. Manufacturers:
   1. Underground Devices Inc., www.udevices.com.
   2. The George-Ingraham Corp.
   3. Or Approved Equal.

2.9 HEAT SHRINK TUBING

A. Provide all-weather corrosion resistant vinyl plastic heat shrink tubing designed for application on the exterior of metallic conduit to protect against galvanic action, moisture or other deteriorating contaminants.

B. Manufacturers:
1. Tycho Electronics, Raychem, www.raychem.com.
2. Thomas & Betts
3. Or Approved Equal.

2.10 WALL AND FLOOR PENETRATION SEALS

A. Provide watertight mechanical seals capable of holding up to 20 psig, and sealing against water, soil, and backfill material.

B. Acceptable Manufacturers:
1. Pipeline Seal & Insulator, Inc., Thunderline/Link-Seal, www.linkseal.com.
2. Flexicraft Industries, PipeSeal, lhttp://flexicraft.com.
3. Or Approved Equal.

2.11 FINISHES

A. Cold Galvanize Coating:
1. Provide a cold galvanize coating to provide protection against corrosion by forming an insoluble zinc salt barrier from a cathodic reaction when the coating is damaged by abrasion and exposed to weather.
   a. Provide a single component pre-mixed liquid organic zinc compound producing 95 percent zinc in the dry film.
   b. Provide a coating that bonds to clean iron, steel, or aluminum through electrochemical action.
2. Acceptable Manufacturers:
   a. ZRC. Worldwide, www.zrcworldwide.com.
   b. Clearco
   c. Krylon
   d. Rustoleum
   e. Or Approved Equal

PART 3 - EXECUTION

3.1 EXAMINATION

A. Although the Contract Drawings are generally indicative of the Work, take field measurements to verify actual conditions.
1. Due to the small scale of the Contract Drawings it is not possible to indicate all offsets, fittings, and apparatus required or the minor structural obstructions that may be encountered during the Work.

B. Inspect the condition of existing conduit that is required for the Work of this Section.

3.2 PREPARATION

A. After carefully investigating structural and finish conditions and other in-place construction work, prepare and submit detailed Shop Drawings showing proposed departures from the original design due to field conditions or other causes.
   1. Layout the electrical work according to accepted standard electrical trade practice to suit actual field measurements.
   2. Arrange the electrical work to consider existing conditions and to preserve access to other equipment, rooms, areas, and similar features of the construction.
   3. Include plan and profile views of duct banks.
   4. Indicate the location and details of conflicting utility construction and slopes.
   5. Submit these Shop Drawings to Metro North Railroad for approval prior to performing the Work of this Section.

B. Submit Product Data and catalog cuts for all products provided under this Section.
   1. Clearly indicate the usage of each product on the submittal.
   2. Include Product Data for the conduit and tubing provided under this Section with the Operation and Maintenance Manuals.

C. Obtain roughing-in dimensions of electrically operated equipment, including equipment being installed by both electrical and other construction trades.
   1. Set conduit and boxes only after receiving approved dimensions and checking such equipment locations.

D. Remove dirt, debris, and other obstructions from existing conduit required for the Work of this Section by blowing out and mandreling the conduits as applicable.

3.3 INSTALLATION

A. Perform the Work of this Section as specified in Section 26 05 00, Basic Electrical Materials and Methods.

B. Fabricate and install conduit and wireway systems in accordance with accepted electrical trade standard practice.
   1. Layout the electrical work of this Section to suit actual field measurements.
      a. Record the actual installed elevations and locations of duct banks and the as-found locations of conflicting utility lines on the record drawings as specified by Metro North, and submit the record drawings.
   2. Install the electrical Work of this Section in conformance to the wiring methods general requirements of Article 300 in NFPA 70 (NEC), and to all other applicable Articles of NFPA 70 governing wiring methods.
   3. Cut conduit and wireway square, and ream the cut ends according to the requirements of NFPA 70 (NEC) to deburr the openings so that they are not restricted more than cuts made by the material manufacturer.
   4. Avoid bending conduits as much as possible and practical; but if bends are made, use an approved conduit bending tool or machine to make the bends.

5. Do not install crushed or deformed conduit, and remove crushed or deformed conduit from the Site.
6. On conduit that is installed outside, provide a second equipment ground conductor and use fittings with a built-in ground lug for bonding.
7. Provide flexible conduit only to the extent permitted by NFPA 70 (NEC).
    a. In flexible conduits that do not have an integral ground wire, install a green insulated wire in addition to the neutral wire for grounding purposes.
        1) Form a 'J' or 'S' hook with a drip loop to allow flexibility.
        2) Provide a second equipment grounding conductor on outside conduit and provide fittings with built-in ground lug for bonding.
    b. In exposed areas, use PVC coated flexible metal conduit and fittings.
    c. Use flexible metal conduit or liquid tight flexible metal conduit for final connection to recessed lighting fixtures and rotating and vibrating equipment.
        1) Flexible Metal Conduit is only permitted for final connections to lighting fixtures in dry, environmentally conditioned spaces.
        2) Liquid tight flexible metal conduit, as herein specified, for final connection to recess mounted lighting fixtures in unconditioned spaces and to all rotating and vibrating equipment including transformers, motors, solenoid valves, pressure switches, limit switches, generators, engine-mounted devices and pipe-mounted devices.
        3) Flexible conduit not to exceed 18 inches in length for motor connections, 36 inches in length for equipment connections or 72-inches for lighting fixture connections.
8. Provide fittings and apparatus as required to construct the approved electrical design.
    a. Running threads on conduit are not permitted.
        1) Where couplings and connectors are required for metal conduits, use approved threaded couplings and connectors.
    b. Provide conduit unions where necessary to complete a conduit run when neither conduit end can be turned.
    c. Where conduit and raceway runs cross building expansion joints, make provision for expansion in the conduit and raceway runs.
    d. Provide sealing fittings with drain fittings in all lower runs and vertical runs.
    e. Provide sealing covers for junction boxes where required.
    f. Provide weatherproof conduit hubs on all conduit connections exterior to the building, and on instruments, process equipment, and pump motors.
9. Installing RGS and PVC Coated Conduit:
    a. Install RGS and PVC coated conduit using methods and techniques recommended by the conduit manufacturer.
    b. Threading Conduit:
        1) Field thread the conduits per the manufacturers instructions.
            a) For PVC coated conduit, first use a cylindrical guide, oversized to fit over the plastic coating, to neatly cut the coating off at the proposed end of the threads.
            b) Do not damage or remove the coating beyond the proposed end of the threads.
        2) Once the threading operation is complete, protect the newly cut threads against corrosion by applying a "sealing" compound as recommended by the manufacturer.
    c. Assembling RGS and PVC Coated Conduit Fittings:
        1) Use PVC coated conduit bodies, clamps, supports, accessories, and fittings with coated conduit systems.

2) Just prior to assembling each conduit joint, apply the conduit manufacturer's touch-up compound to the end of the conduit in the area normally covered by the fitting sleeve.
3) Use cloth or other material over strap type wrenches to protect the coating while tightening conduits.

10. Breathers and drains shall be provided at the low point(s) of all conduit runs in NEMA 3R, 4, 4X and 7 areas, and where otherwise subject to the accumulation of condensation. Conduits shall be arranged to drain away from dry areas toward damp or wet areas, and away from equipment and enclosures.

C. Exposed Work:
1. In exposed work, run conduit and raceway parallel to centerlines and structure surfaces; or perpendicular to centerlines where required, with right angle turns consisting of symmetrical bends or fittings.
2. Maintain at least 6 inches clearance between conduit and raceway runs and pipes, ducts, and flues of mechanical systems.
3. If a portion of a metallic conduit run, whether plastic-coated or not, extends above grade or is otherwise exposed to personnel, ensure that the conduit is properly bonded to an equipment grounding conductor at both ends.
4. Install the equipment grounding conductor either inside or outside the box.

D. Concealed Work:
1. When performing electrical work in concealed spaces, provide the same quality workmanship as in exposed work.
2. Conceal conduits and raceways in the structure's construction where practicable unless otherwise indicated on the Contract Drawings or required by the Engineer.
a. Group conduit and raceway runs in concealed work as much as practical to avoid congesting the concealed spaces.
b. Do not weaken the structure by excessive or unnecessary cutting.
1) Only make cuts into the structure's construction in conformance to the applicable building codes.
3. Conduits and Raceways Embedded in Concrete Slabs:
a. Separate multiple conduits encased together by not less than two inches of concrete.
b. Locate conduit installed in floor slabs within the reinforced area of the slab.
c. Where conduit crosses expansion joints, provide weather tight expansion and defection fittings and bonding jumpers.
4. Install below grade conduit in conformance with the requirements of Section 33 71 19, Underground Ducts and Manholes.
a. For conduits that pass under building support walls, provide a minimum of 3 inches of concrete encasement all around.
b. For underground and concrete encased duct banks, provide non-metallic conduit spacers.
1) Provide sufficient space to allow pouring the concrete envelope without displacing or shifting the individual conduits.
2) Install conduit spacers at intervals not exceeding five feet.

E. Hangers and Supports:
1. Install auxiliary support structures, anchors, and fasteners as specified in Section 26 05 28, Hangers and Supports.

a. Mount or suspend conduit and wireway systems directly on structural members of the structures and walls.
b. Do not attach conduit or raceway systems to suspended ceiling members or to the suspending mediums.
c. Securely attach anchors into walls.

2. At all conduit attachments, allow space between the mounting surfaces and the conduit by providing U-channel supports, clamp-backs, or spacers.
   a. Attach wall-mounted conduit runs close to the walls following the contour of the walls, parallel to the walls and other building lines except at bends.

F. Structure Penetrations:
1. Make penetrations in existing concrete structures by core-drilling.
   a. Drill the penetrations true, clean, and free from spalling.
2. At penetrations through fire rated floors, walls, and similar assemblies, provide firestopping as specified in Section 07 84 00, Firestopping.
3. Make floor penetrations as detailed on the Contract Drawings.
   a. Seal all conduit penetrations through floor slabs on grade in buildings with a floor penetration seal.
4. Install a wall penetration seal at all wall penetrations.
   a. Size wall penetrations to accommodate the conduit outside diameter plus either 1/4 inch or a hole allowance to allow the installation of the wall penetration seal.
5. For conduits that enter rooms from concrete floors or masonry, provide corrosion protection by using an RGS or PVC coated conduit that extends from 12 inches inside the concrete or masonry to at least 6 inches into the room.

G. Hazardous Locations
1. Within the areas labeled as “hazardous” on the Contract Drawings, only provide equipment, fittings, and wiring as indicated which are approved for Class 1, Division 1, Group D or Class II, Division 1, Group F locations as required by NFPA 70 (NEC) for the type of area in question and as specifically designed for this type of hazardous use.
2. In hazardous locations, engage at least five full threads on conduit connections to couplings and fitting hubs.
   a. Coat the threads with a sealing compound that makes the connections gas tight
3. Properly install sealing fittings at all required locations in accordance with code regulations.

H. Wiring:
1. Install wiring in conduit as indicated.
2. Prior to the installation of any wire, verify that the conduit is clean and free of debris.
3. Install a separate ground conductor within every conduit.

3.4 FIELD QUALITY CONTROL

A. Inspection:
1. Inspect installed conduit runs for obstructions, proper support, proper grounding, and completeness.
2. Record the actual installed elevations and locations of conduit and tubing on record drawings specified by Metro North.

END OF SECTION

SECTION 28 46 20 – FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1. DESCRIPTION:

A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.

B. The fire alarm system shall comply with requirements of NFPA Standard No. 72 for Local Protected Premises Signaling Systems except as modified and supplemented by this specification. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.

1. The Secondary Power Source of the fire alarm control panel shall provide at least 24 hours of backup power with the ability to sustain 5 minutes in alarm at the end of the backup period.

2, The contractor shall provide fire alarm devices suited and listed for the location indicated on the contract drawings.

C. The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

D. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).

E. Underwriters Laboratories Inc. (UL) - USA:

UL 38 Manually Actuated Signaling Boxes
UL 217 Smoke Detectors, Single and Multiple Station
UL 268 Smoke Detectors for Fire Protective Signaling Systems
UL 268A Smoke Detectors for Duct Applications
UL 464 Audible Signaling Appliances
UL 521 Heat Detectors for Fire Protective Signaling Systems
UL 864 Standard for Control Units for Fire Protective Signaling Systems
UL 1481 Power Supplies for Fire Protective Signaling Systems
UL 1610 Central Station Burglar Alarm Units
UL 2075 Standard for Gas and Vapor Detectors and Sensors
UL 1638 Visual Signaling Appliances
UL 2017 General-Purpose Signaling Devices and System

1. The FACP shall be ANSI 864, 10th Edition Listed. Systems listed to ANSI 864, 8th edition (or previous revisions) shall not be accepted.

F. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final check-out and to ensure the systems integrity.

1.2. SCOPE:

A. An intelligent, microprocessor-controlled, fire alarm detection system shall be installed in accordance to the project specifications and drawings. Fire alarm Equipment and devices shall be suited or listed to the location as indicated in the contract drawing.

B. Basic Performance:

1. Initiation Device Circuits (IDC) shall be wired NFPA Style B (Class B) as part of an addressable device connected by the SLC Circuit.

2. When not wired directly from panel NAC circuits, Notification Appliance Circuits (NAC) shall be wired NFPA Style Y (Class B) as part of an addressable device connected by the SLC Circuit.

3. All circuits shall be power-limited, per UL864 requirements.

4. A single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

5. Alarm signals arriving at the main FACP shall not be lost following a primary power failure or outage of any kind until the alarm signal is processed and recorded.

6. Panel shall meet requirements of UL-864 10th Edition

C. BASIC SYSTEM FUNCTIONAL OPERATION

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

1. The system Alarm LED on the FACP shall flash.

2. A local sounder with the control panel shall sound.

3. A backlit 80-character LCD display on the FACP shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

4. In response to a fire alarm condition, the system will process all control programming and activate all system outputs (alarm notification appliances and/or relays) associated with the point(s) in alarm

5. In response to a fire alarm condition, the system will process all control programming and activate all system outputs (alarm notification appliances and/or relays) associated with the point(s) in alarm. Additionally, the system shall send events to a central alarm supervising station via either dial-up over PSTN, IP, Cellular, Internet, Intranet via PSDN or virtual private network.

1.3. SUBMITTALS

A. General:

1. Two copies of all submittals shall be submitted to the Architect/Engineer for review.

2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent compatible UL-listed equipment from other manufacturers may be substituted for the specified equipment, if the minimum standards are met.

3. For equipment, other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.

3. Show annunciator layout, configurations, and terminations.

C. Manuals:

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.

2. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.

3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

D. Software Modifications

1. Provide the services of a qualified technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.

2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

3. Provide firmware updates through USB thumb drive.

1.4. GUARANTY:

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period, shall be included in the submittal bid.

1.5. MAINTENANCE:

A. Maintenance and testing shall be on a semi-annual schedule or as required by the local AHJ. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The schedule shall include:

1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, waterflow switches and all accessories of the fire alarm system.

2. Each circuit in the fire alarm system shall be tested semiannually.

3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72 Chapter 10.

B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, tests, and repairs described below. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

1.6. POST CONTRACT EXPANSIONS:

A. The contractor shall have the ability to provide parts and labor to expand the system specified, if so requested, for a period of five (5) years from the date of acceptance.

B. As part of the submittal, include a quotation for all parts and material, and all installation and test labor as needed to increase the number of intelligent or addressable devices by ten percent (10%). This quotation shall include intelligent smoke detectors, CO detectors intelligent heat detectors, addressable manual stations, addressable monitor modules and addressable control modules equal in number to one tenth of the number required to meet this specification (list actual quantity of each type).

C. The quotation shall include installation, test labor, and labor to reprogram the system for this 10% expansion. If additional FACP hardware is required, include the material and labor necessary to install this hardware.

D. Do not include cost of conduit or wire or the cost to install conduit or wire except for labor to make final connections at the FACP and at each intelligent addressable device. Do not include the cost of conventional peripherals or the cost of initiating devices or notification

appliances connected to the addressable monitor/control modules.

E. Submittals that do not include this estimate of post contract expansion cost will not be accepted.

1.7. APPLICABLE STANDARDS AND SPECIFICATIONS:

The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

A. National Fire Protection Association (NFPA) - USA:

No. 70 National Electric Code (NEC)
No. 72 National Fire Alarm Code
No. 101 Life Safety Code

B. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

C. Local and NY State Building Codes.

D. All requirements of the Authority Having Jurisdiction (AHJ).

1.8. APPROVALS:

A. The system shall have proper listing and/or approval from the following nationally recognized agencies:

UL Underwriters Laboratories Inc (Ninth Edition)

FM Factory Mutual

MEA Material Equipment Acceptance (NYC)

CSFM California State Fire Marshal

PART 2.0 PRODUCTS

2.1. EQUIPMENT AND MATERIAL, GENERAL:

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a fire protective signaling system, meeting the National Fire Alarm Code.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2. CONDUIT AND WIRE:

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.

2. Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.

3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.

4. With the exception of telephone connections, wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.

6. Conduit shall be 3/4 inch (19.1 mm) minimum.

B. Wire:

1. All fire alarm system wiring shall be new.

2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits and Signaling Line Circuits, and 14 AWG (1.63 mm) for Notification Appliance Circuits.

3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.

4. All fire alarm cable shall be installed in conduit.

5. Wiring used for the multiplex communication circuit (SLC) shall be twisted non-shielded and support a minimum wiring distance of 10,000 feet when sized at 12 AWG.

6. All field wiring shall be electrically supervised for open circuit and ground fault.

7. The fire alarm control panel shall be capable of T-tapping NFPA Style 4 (Class B) Signaling Line Circuits (SLCs). Systems which do not allow or have restrictions for the number of T-taps, length of T-taps etc., are not acceptable.

C. Terminal Boxes, Junction Boxes and Cabinets:
All boxes and cabinets shall be UL listed for their use and purpose.

D. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod. The control panel enclosure shall feature a quick removal chassis to facilitate rapid replacement of the FACP electronics.

1. The FACP shall be capable of coding Notification Appliance Circuits in March Time Code (120 PPM), Temporal 3 code. Main panel notification circuits (NACs 1 & 2) shall also automatically synchronize any of the following manufacturer's notification appliances connected to them: System Sensor, Wheelock, and Gentex, with no need for additional synchronization modules.

2.3. MAIN FIRE ALARM CONTROL PANEL:

A. The FACP shall be a Fire-Lite Model ES-50X, ES-200X and shall contain a microprocessor-based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, Digital Dialer and Ethernet Communicators and other system controlled devices. Ethernet communications shall be via a IPOTs card.

B. Operator Control

1. Acknowledge Switch:

a. Activation of the control panel Acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the 80-character LCD display to the next alarm or trouble condition.

b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

2. Alarm Silence Switch:

Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silence able by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

3. Alarm Activate (Drill) Switch:

The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

4. System Reset Switch:

Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.

5. Lamp Test:

The System RESET switch shall also function as a Lamp Test switch and shall activate all system LEDs and light each segment of the liquid crystal display.

6. Programmable Buttons:

The system should have at a minimum 4 programmable function keys for quick zone and NAC disable during maintenance.

C. System Capacity and General Operation

1. The control panel shall provide, or be capable of, expansion to 50 intelligent/addressable devices of any type, detector or module

2. The control panel shall include two Form-C programmable relays, which can be used for Alarm, and Supervisory and a fixed Trouble relay rated at a minimum of 2.5 amps @ 30 VDC. It shall also include 2 programmable Notification Appliance Circuits (NACs) capable of being wired as NFPA Style Y (Class B) or NFPA Style Z (Class A). Either programmable Notification circuit shall also can provide auxiliary power when programmed as such.

3. The fire alarm control panel shall include an operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color-coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.

4. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel. The system shall be fully programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes. The control unit will support the ability to upgrade its operating program using FLASH memory technology. The unit shall provide the user with the ability to program from either the included keypad or a USB drive programmed from FS-Tools.

5. The system shall allow the programming of any input to activate any output or group of outputs. Systems which have limited programming (such as general alarm), have

complicated programming (such as a diode matrix), or REQUIRE a laptop personal computer is not considered suitable substitutes.

6. The FACP shall provide the following features:

a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.

b. Detector sensitivity test, meeting requirements of NFPA 72, Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.

c. The ability to display or print system reports.

d. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification an excessive number of times.

e. Positive Alarm Sequence (PAS presignal), meeting NFPA 72 requirements.

f. Rapid manual station reporting.

g. Non-alarm points for general (non-fire) control.

h. Periodic detector test, conducted automatically by the software.

i. Walk test, with a check for two detectors set to same address.

j. Universal end of line resistor for NACs and remote sync output

k. Temporal-4 NAC coding for CO alarms.

l. Built in Class-A capability for all 4 NACs

m. Local upload/download using USB drive.

n. Flash firmware with USB thumb drive.

7. The FACP shall be capable of coding Notification Appliance Circuits in March Time Code (120 PPM), Temporal 3 (NFPA 72) for fire alarm and CO alarm Code. Main panel notification circuits (NACs 1 & 2) shall also automatically synchronize and be programmable for any of the following manufacturer's notification appliances connected to them: System Sensor, Wheelock, Gentex, with no need for additional synchronization modules

B. Display

1. The display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters.

2. The display shall include status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.

3. The display shall contain an alphanumeric, text-type display and dedicated LEDs for the annunciation of AC POWER, FIRE ALARM, SUPERVISORY, TROUBLE, , and ALARM SILENCED, CO Alarm conditions.

4. The display keypad shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.

5. The display shall include the following operator control switches: ACKNOWLEDGE/STEP, ALARM SILENCE, DRILL (alarm activate), and SYSTEM RESET.

C. Signaling Line Circuit (SLC)

1. The SLC interface shall provide power to and communicate with up to 50 devices of any type including: intelligent detectors (ionization, photoelectric, CO or thermal) addressable pull stations, addressable Beam Detectors, intelligent modules (monitor or control). Each SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.

2. The CPU shall receive information from all intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall automatically compensate for the accumulation of dust in each detector up to allowable limits. The information shall also be used for automatic detector testing and for the determination of detector maintenance conditions.
3. The detector software shall meet NFPA 72, Chapter 10 requirements and be certified by UL as a calibrated sensitivity test instrument.

D. Serial Interfaces

1. An annunciator RS-485 bus shall be used to connect an UL-Listed 80-column printer anywhere within the 6,000 range of the serial bus connection. The printer shall communicate with the control panel using an RS-485 converter/interface complying with Electrical Industries Association standard EIA-232D. Power to the printer shall be 120 VAC @ 60 Hz. The interface shall contain both a 9-pin serial and standard centronics parallel connector. Either shall be capable of connection to a serial or parallel printer. The bus shall also provide connection to additional addressable modules supporting remote 80 character LCD text annunciators that mimic the standard panel display and controls. Said annunciators shall support remote acknowledge, silence, drill and reset functions and shall be enabled via a keyswitch. The bus shall also provide connection to addressable modules supporting up to 40 LEDs for use with a graphic annunciator.

E. The control panel will have the capability of Reverse Polarity Transmission or connection to a Municipal Box for compliance with applicable NFPA standards.

F. Internet Protocol Over Telephone Service (IPOTS) is an interface for communicating digital information between a fire alarm control panel and a UL-Listed central station. The IPOTs module is capable of transmitting contact ID formatted alarms to a central station equipped with a compatible IP receiver via

Ethernet over a private or public WAN/LAN, Intranet or Ethernet.

1. The IPOTS communicator shall be an integral module component of the fire alarm control panel enclosure.

2. The IPOTS communicator shall be completely field-programmable locally from a USB port or via Ethernet,Telnet and through AlarmNet.

3. The IPOTS communicator shall be capable of transmitting events in contact ID format.

4. Communication shall include vital system status such as:

- Independent Zone (Alarm, trouble, non-alarm, supervisory)
- Independent Addressable Device Status
- AC (Mains) Power Loss
- Low Battery and Earth Fault
- System Off Normal
- 12 and 24 Hour Test Signal
- Abnormal Test Signal (per UL requirements)
- EIA-485 Communications Failure
- IP Line Failure

5. The IPOTS communicator shall support independent zone/point reporting. In this format, the IPOTS shall support the transmission of addressable points within the system. This format shall enable the central station to have exact details concerning the location of the fire for emergency response. The communication over IP / cellular shall be transparent to the panels normal operation over phone lines.

7. The IPOTS communicator shall utilize a supervisory heart beat signal of no less than once every 90 seconds insuring multiplexed level line supervision. Loss of Internet or Intranet connectivity shall be reported in no more than 200 seconds. This IPOTS communicator can also can program communication in supervisor according to all NFPA guidelines. Alarm events shall be transmitted to a central station in no less than 90 seconds from time of initiation to time of notification.

G. Enclosures:

1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected and painted red via the powder coat method with manufacturer's standard finish.

2. The back box and door shall be constructed of steel with provisions for electrical conduit connections into the sides and top.

3. The door shall provide a key lock and shall provide for the viewing of all indicators.

4. The cabinet shall accept a chassis containing the PCB and to assist in quick replacement of all the electronics including power supply shall require no more than two bolts to secure the panel to the enclosure back box.

5. The cabinet shall also support a mechanical secured optional dress panel limiting access to the internals of the panel.

H. Field Charging Power Supply:

The FCPS is a device designed for use as either a remote 24-volt power supply or as a booster for powering Notification Appliances.

1. The FCPS shall offer up to 8.0 amps (6.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 18.0 amp hour batteries.

2. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a control relay. Four NAC outputs, wired NFPA Style Y or Z, shall be available for connection to the Notification devices.

3. The FCPS shall optionally provide synchronization of all connected strobes or horn strobe combinations when System Sensor, Wheelock or Gentex devices are installed.

4. The FCPS shall function as a sync follower as well as a sync generator.

5. The FCPS shall include a surface mount backbox.

6. The Field Charging Power Supply shall include the ability to delay the reporting of an AC fail condition per NFPA requirements.

7. The FCPS shall provide 24 VDC regulated and power-limited circuitry per UL standards. Should this be updated to latest UL standard?

I. Power Supply:

1. The main power supply for the fire alarm control panel shall provide up to 3.0 amps For ES-50X, up to 6.0 amps for ES-200 available power for the control panel and peripheral devices.

2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.

3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger or may be used with an external battery and charger systems. Battery arrangement may be configured in the field.

4. The main power supply shall continuously monitor all field wires for earth ground conditions.

5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.

J. Programmable Electronic Sounders:

1. Electronic sounders shall operate on 24 VDC nominal.

2. Electronic sounders shall be field programmable without the use of special tools, to provide slow whoop, continuous, or interrupted tones with an output sound level of at least 90 dBA measured at 10 feet from the device.

3. Electronic sounders shall be flush or surface mounted as shown on plans.

K. Fire Alarm Horn Strobe Combination (indoor).

The horn/strobe shall be a System Sensor L-Series line of wall-mounted model with field-selectable candela settings: 15, 30, 75, 95, 110, 135, and 185. Device shall be listed to UL 1971 and UL 464 and shall be approved for fire protective service. The strobe shall be wired as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The horn shall have two audibility options and an option to switch between a temporal three pattern and a non-temporal (continuous) pattern.

L. Fire Alarm Horn Strobe Combination (outdoor).

The horn/strobe shall be a SpectrAlert Advance outdoor Horn/ Strobe of wall-mounted model (weatherproof per NEMA 4X, IP56), red plastic housings, with field-selectable candela settings: 15, 30, 75, 95, 110, 135, and 185. Device shall be listed to UL 1638 and UL 464 and shall be approved for fire protective service. Shall be tamper-resistant construction and rated from -40F to 151F. Shall be compatible with System Sensor synchronization protocol. The horn shall have two audibility options and an option to switch between a temporal three pattern and a non-temporal (continuous) pattern.

M. Specific System Operations

1. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently programmed for verification of alarm signals. The alarm verification time period shall not exceed 2 minutes.

2. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.

3. Point Read: The system shall be able to display the following point status diagnostic functions:

a. Device status
b. Device type
c. Custom device label
d. Device zone assignments

4. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.

5. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 500 events. Each of these activations

will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety.

The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.

6. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

7. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.

8. The fire alarm control panel shall include Silent and Audible Walk Test functions – Silent and Audible. It shall include the ability to test initiating device circuits and Notification Appliance Circuits from the field without returning to the panel to reset the system. The operation shall be as follows:

a. The Silent Walk Test will not sound NACs but will store the Walk Test information in History for later viewing.

b. Alarming an initiating device shall activate programmed outputs, which are selected to participate in Walk Test.

c. Introducing a trouble into the initiating device shall activate the programmed outputs.

d. Walk Test shall be selectable on a per device/circuit basis. All devices and circuits which are not selected for Walk Test shall continue to provide fire protection and if an alarm is detected, will exit Walk Test and activate all programmed alarm functions.

e. All devices tested in walk test shall be recorded in the history buffer.

9. Waterflow Operation: An alarm from a waterflow detection device shall activate the appropriate alarm message on the control panel display; turn on all programmed Notification Appliance Circuits and shall not be affected by the Signal Silence switch.

10. Supervisory Operation: An alarm from a supervisory device shall cause the appropriate indication on the control panel display, light a common supervisory LED, but will not cause the system to enter the trouble mode.

11. Signal Silence Operation: The FACP shall have the ability to program each output circuit (notification circuit or relay) to deactivate upon depression of the Signal Silence switch.

12. Non-Alarm Input Operation: Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

13. Programmable functionality: programmable buttons F1, F2, F3, F4 to allow simple routine maintenance tasks be programmed.

14. Detection of unprogrammed devices: The FACP will automatically detect and report unprogrammed SLC devices to ensure all devices are recognized.

1.9. SYSTEM COMPONENTS:

A. Addressable Pull Box (manual station)

1. Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

3. Manual pull stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

B. Intelligent Multi-Sensing Detector

1. The intelligent detector shall be an addressable device which is capable of detecting multiple threats by employing photoelectric and thermal technologies in a single unit. This detector shall utilize advanced electronics which react to slow smoldering fires (photoelectric) and heat (thermal) all within a single sensing device.

2. The multi-detector shall include two LEDs for 360-degree viewing.

3. Automatically adjusts sensitivity levels without the need for operator intervention or programming. Sensitivity increases with heat.

C. Intelligent Photoelectric Smoke Detector

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

2. The detectors shall be ceiling-mounted and available in an alternate model with an integral fixed 135-degree heat-sensing element.

3. Each detector shall contain a remote LED output and a built-in test switch.

4. Detector shall be provided on a twist-lock base.

5. It shall be possible to perform a calibrated sensitivity and performance test on the detector without the need for the generation of smoke. The test method shall test all detector circuits.

6. A visual indication of an alarm shall be provided by dual latching Light Emitting Diodes (LEDs), on the detector, which may be seen from ground level over 360 degrees. These LEDs shall periodically flash to indicate that the detector is in communication with the control panel.

7. The detector shall not go into alarm when exposed to air velocities of up to 1500 feet per minute (fpm).

8. The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.

9. All field wire connections shall be made to the base through the use of a clamping plate and screw.

E. Projected Addressable Beam Detector

1. The projected beam type shall be a 4-wire 24 VDC intelligent, addressable projected beam smoke detector device.

2. The detector shall be listed to UL 268 and shall consist of a single transmitter\receiver and corresponding non powered reflector.

3. The detector shall operate in either a short range (16' - 230') or long range (16' - 328') when used with an extender module.

4. The temperature range of the device shall be -22 degrees F to 131 degrees

5. The detector shall feature an optical sight and 2-digit signal strength meter to ensure proper alignment of unit without need of special tools.

6. The unit shall be both ceiling and wall mountable.

7. The detector shall have the ability to be tested using calibrated test filters or magnet-activated remote test station.}

8. The detector shall have four standard sensitivity selections along with two automatic self-adjusting settings. When either of the two automatic settings is selected the detector will automatically adjust its sensitivity using advanced software algorithms to select the optimum sensitivity for the specific environment.

F. Intelligent Ionization Smoke Detector

1. The detectors shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel

representing the analog level of products of combustion.

G. Intelligent Thermal Detectors

1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

H. Multicriteria Fire/CO Detectors

1. Fire detector combines four separate sensing elements in one unit (smoke, CO, light/flame, and heat) to sense multiple components of a fire with programmable response.

I. Intelligent Duct Smoke Detector

1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.

2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

J. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any normally open dry contact device) to one of the fire alarm control panel SLCs.

2. The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.

3. The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

4. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

K. Two-Wire Detector Monitoring

1. Means shall be provided for the monitoring of conventional Initiating Device Circuits populated with 2-wire smoke detectors as well as normally-open contact alarm initiating devices (pull stations, heat detectors, etc).

2. Each IDC of conventional devices will be monitored as a distinct address on the polling circuit by an addressable module. The module will supervise the IDC for alarms and circuit integrity (opens).

3. The monitoring module will be compatible, and listed as such, with all devices on the supervised circuit.

4. The IDC zone may be wired for Style D or Style B (Class A or B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

5. The monitoring module shall be capable of mounting in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box or in an surface mount backbox.

L. Addressable Control Relay Module

1. Addressable control relay modules shall be provided to control the operation of fan shutdown and other auxiliary control functions.

2. The control module shall mount in a standard 4-inch square, 2-1/8 inch deep electrical box, or to a surface mounted backbox.

3. The control relay module will provide a dry contact, Form-C relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relays may be energized at the same time on the same pair of wires.

4. The control relay module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

M. Six Output Addressable Control Relay Module

1. Up to 6 Addressable intelligent control relay modules combined on one circuit board shall be provided to control the operation of fan shutdown and other auxiliary control functions.

2. Using rotary address switches, the first module shall be addressed from 01 to 45 while the remaining modules shall be automatically assigned to the next five higher addresses. Note, binary dip switches for setting address are not acceptable.

3. Provision shall be included for disabling a maximum of three unused modules

4. A single isolated set of dry relay form C contacts shall be provided for each of the 6 module addresses, which shall be capable of being wired for either a normally-open or normally-closed operation.

5. The module shall allow an addressable control panel to switch these contacts on command.

6. The module shall contain removable plug in terminal blocks capable of supporting 12 AWG to 18 AWG wire.

7. The control relays mounted on the module shall be suitable for pilot duty applications and rated for a maximum of 3.0 amps at 30 VDC, resistive, non-coded and 2.0 amps at 30

VDC maximum, resistive, coded.

N. Six-Zone Interface Module

1. A six zone interface module shall be provided as an interface between the addressable panel and two-wire conventional detection zones.

2. A common SLC input shall be used for all modules, and the initiating device circuits shall share a common external supervisory supply and ground.

3. The first address on the interface module shall be addressed from 01 to 45 while the remaining modules are automatically assigned to the next five higher addresses.

4. Address shall be set using decimal encoded rotary address switches. Binary address switches are not acceptable.

5. Provision shall be included for disabling a maximum of two unused addresses of the six available.

6. All two-wire detectors being monitored shall be two-wire compatibility listed with the six zone input module.

7. The six zone input module shall transmit the status of a zone of two-wire detectors to the fire alarm control panel. Status shall be reported as normal, open or alarm.

8. Removable plug-in terminals shall be provided capable of accepting from 18 AWG up to 12 AWG wire.

O. Multiple Two-Wire Detector Monitoring

1. A single multi input module shall be provided for the monitoring of up to 10 conventional Initiating Device Circuits populated with 2-wire smoke detectors as well as normally-open contact alarm initiating devices (pull stations, heat detectors, etc).

2. Each IDC of conventional devices will be monitored as a distinct address on the polling circuit by an addressable point. The module will supervise the IDC for alarms and circuit integrity (opens).

3. The first address on the 10 input boards shall be set from 01 to 40 and the remaining module addresses shall be automatically assigned to the next nine higher addresses.
4. Provision shall be included for disabling a maximum of two unused addresses.

5. The supervised state (normal, open, or short) of the monitored device shall be sent back to the panel. A common SLC input shall be used for all modules, and the initiating device loops shall share a common supervisory supply and ground.

6. The IDC zone may be wired for Style D or Style B (Class A or B) operation. A green LED for each circuit shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel. LEDs shall latch on when a circuit is in alarm.

P. Isolator Module

1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Style 6 (Class A) or Style 4 (Class B branch). The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.

2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.

3. The isolator module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

4. The isolator module shall mount in a standard 4-inch (101.6 mm) deep electrical box or in a surface mounted backbox. It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

Q. Serially Connected Graphic LED driver module

1. An LED driver module shall communicate with the fire alarm control panel via a two wire EIA 485 (multi-drop) communications circuit.

2. The annunciator shall require no more than two wires for operation and two wires for power. Annunciation shall include Outputs for up to 40 LEDs.
   a. Up to 8 total devices of any kind, LCD, printer gateway, LED, Relay or I/O module may be installed on the ANN-BUS.

R. Alphanumeric LCD Type Annunciator:

1. The alphanumeric display annunciator shall be a supervised, remotely located back-lit eighty (80) characters LCD display for alarm annunciation in clear English text.
2. The LCD annunciator shall display all alarm and trouble conditions in the system.

3. An audible indication of alarm shall be integral to the alphanumeric display.

4. The display shall be UL listed for fire alarm application.

5. It shall be possible to connect up to 8 LCD displays and be capable of wiring distances up to 6,000 feet from the control panel.

6. The annunciator shall connect to a separate, dedicated "terminal mode" EIA-RS-485 interface using two-wire loop connection and 2 wires for power. Each terminal mode LCD display shall mimic the main control panel.

S. Field Wiring Terminal Blocks

For ease of connection for heavy solid gage wire, all panel I/O wiring terminal blocks shall be screw type barrier strips and have sufficient capacity for #18 to #12 AWG wire.

1.10. SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices - General

1. Addressable devices shall employ the simple-to-set decade addressing scheme. Addressable devices which use a binary-coded address setting method, such as a DIP switch, are not an allowable substitute.

2. Detectors shall be addressable and intelligent, and shall connect with two wires to the fire alarm control panel signaling line circuits.

3. Addressable smoke and thermal (heat) detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED.

4. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 10.

5. Detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a base with a built-in (local) sounder rated for a minimum of 85 DBA, a relay base and an isolator base designed for Style 7 applications.

6. Detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel.

7. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL, CO).

8. Detectors shall provide address-setting means using decimal switches.

1.11. BATTERIES:

A. Upon loss of Primary (AC) power to the control panel, the batteries shall have sufficient capacity to power the fire alarm system for required standby time (24 or 60 hours) followed by 5 minutes of alarm.

B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

C. If necessary to meet standby requirements, external battery/charger systems may be used.

PART 3.0 - EXECUTION

3.1. INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

D. Manual pull stations shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2. TEST:

The service of a competent, NICET level II technician shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 10.

A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

C. Verify activation of all waterflow switches.

D. Open initiating device circuits and verify that the trouble signal actuates.

E. Open and short signaling line circuits and verify that the trouble signal actuates.

F. Open and short notification appliance circuits and verify that trouble signal actuates.

G. Ground all circuits and verify response of trouble signals.

H. Check presence and audibility of tone at all alarm notification devices.

I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.

J. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

K. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3. FINAL INSPECTION:

A. At the final inspection, a minimum NICET Level II technician shall demonstrate that the system functions properly in every respect.

3.4. INSTRUCTION:

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor or installing dealer shall provide a user manual indicating "Sequence of Operation."

END OF SECTION

SECTION 32 01 17 – REFLECTIVE CRACKING MEMBRANE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contract Drawings and other Contract Documents, including the General Conditions, Supplementary Conditions, and Division 01 Specification Sections, apply to the Work of this Section.

B. Related Sections include the following:
   1. Section 01 33 00 Submittal Procedures.

1.2 SUMMARY

A. Under this section, the Contractor shall furnish and install a membrane over the joints of new concrete base prior to the placement thereon of asphaltic concrete overlay in order to inhibit reflective cracking from the pavement to the overlay. The membrane shall be installed where required, in accordance with the specifications and the directions of the Engineer.

1.3 SUBMITTALS

A. Action Submittals:
   1. Submit the following to the Engineer for approval in accordance with the requirements of Section 01 33 00, Submittal Procedures:
      a. Product Data.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The membrane shall be a pavements fabric system at least twelve (12”) inches wide. The following types, or approved equivalents, are acceptable:
   1. Type: Glass fiber woven fabric, primer, and binder system:
      a. Manufacturer: Owens-Corning Fiberglas Corp., Granville Ohio, 43023. Product: Roadglas reinforcement, Roadbond X-100 primer, and Roadbond binder.
   2. Type: Non-woven polypropylene fabric precoated with a rubberized adhesive base
      a. Manufacturer: Phillips Fibers Corp., Engineering Products Marketing P.O. Box 66, Greenville, S.C. 29602. Product: Petrotac
      b. Manufacturer: W.R. Grace & Co. Construction Products Div. Cambridge, Mass. 02140. Product: Bituthene S-5300.

PART 3 - PRODUCTS

3.1 PREPARATION

A. Ensure substrates are in suitable condition to receive the work.
   1. The surface on which the membrane is to be placed shall be dry and free from dust, dirt, mud, oil, grease, vegetation and other contaminants.
   2. All joints greater than one-eight (1/8) inch wide shall be cleaned by pneumatic means and filled with Asphaltic Cement filler, as directed by the Engineer.

3.2 INSTALLATION

1. The membrane shall be placed over the joints in strict accordance with the manufacturer's instructions and the Drawings. Roll ends shall be overlapped four (4) to six (6) inches.
2. Placement of the asphaltic concrete overlay shall closely follow membrane laydown. No more membrane than can be overlaid on the same working day shall be placed.

3.3 PROTECTION

A. Traffic:
   1. No traffic of any kind will be allowed on the pavement until permitted by the Engineer.

END OF SECTION

SECTION 32 12 00 - FLEXIBLE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contract Drawings and other Contract Documents, including the General Conditions, Supplementary Conditions, and Division 01 Specification Sections, apply to the Work of this Section.

B. Related Sections include the following:
   1. Section 01 33 00 Submittal Procedures.

1.2 SUMMARY

A. This Section specifies requirements for existing ground preparation and asphaltic concrete paving.

1.3 REFERENCES

A. Reference Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. AASHTO T 168 – Standard Method of Test for Sampling Bituminous Paving Mixtures.
      b. AASHTO T 245 – Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
   2. ASTM International (ASTM):
      a. ASTM D 29 – Standard Test Methods for Sampling and Testing Lac Resins [withdrawn 2005 without replacement].
      b. ASTM D 36 - Standard Test Method for Softening Point of Bitumen (Ring-and- Ball Apparatus).
      c. ASTM D 464 - Standard Test Methods for Saponification Number of Naval Store Products Including Tall Oil and Other Related Products.
      d. ASTM D 465 - Standard Test Methods for Acid Number of Naval Stores Products Including Tall Oil and Other Related Products.
      e. ASTM D546 Standard Test Method for Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures
      f. ASTM D692 Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures
      g. ASTM D946 Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
      h. ASTM D1073 Standard Specification for Fine Aggregate for Bituminous Paving Mixtures
      i. ASTM D1188 Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
      j. ASTM D 2041 - Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.
      k. ASTM D2726 Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures

l. ASTM D2950 - 09 Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
m. ASTM D3549 Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens

3. American Wood Preserver's Association (AWPA):
   a. AWPA P5 Standard for Waterborne Preservatives.
   b. AWPA C1 Pressure Treatment.
   c. AWPA C14 Pressure Treatment – Highway.
4. State of New York:
   a. New York State Department of Transportation (NYSDOT):
      i. NYSDOT Standard Specifications (U.S. Customary Units). https://www.dot.ny.gov/main/business-center/engineering/specifications.
      ii. New York State Standard Sheets (U.S. Customary Units). https://www.dot.ny.gov/main/business-center/engineering/cadd-info/drawings/standard-sheets-us.
   b. Official Compilation of the Rules and Regulations of the State of New York (NYCRR).
      i. 12 NYCRR Part 23 - Protection in Construction, Demolition and Excavation Operations.
      ii. 16 NYCRR Part 753 - Protection of Underground Facilities.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Testing Laboratory:
      a. Metro-North will engage a qualified testing agency to perform tests and inspections as per Section 01 45 29 Testing Laboratory Services.

1.5 SUBMITTALS

A. Action Submittals:
   1. Submit the following to the Engineer for approval in accordance with the requirements of Section 01 33 00, Submittal Procedures:
      a. Product Data:
         i. Design mix formula to be used.
         ii. Sources of all ingredient materials, copies of all aggregate tests, penetration of the asphaltic cement, and percentages by weight and number of pounds of each of the materials making up the batch.
      b. Certificates:
         i. NYSDOT certified mixing plant to be used. Provide proof of certification.
      c. Special Procedure Submittals:
         i. Specifications of equipment to be used for paving operations.

B. Informational Submittals:
   1. Submit the following to the Engineer for information in accordance with the requirements of Section 01 33 00, Submittal Procedures:
      a. Site Quality Control Submittals:
         i. Test reports, trip tickets, temperature records and other certifications that show materials are in compliance with specifications.
      b. Final density and smoothness test results.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:
   1. Transport asphaltic mixtures in tight vehicles having clean and smooth metal beds.
      a. When necessary, insulate truck bodies.
      b. Just before the vehicles are loaded, lightly coat the inside surface of the vehicles with a whitewash of lime and water, soap solutions, or detergents as approved by the Engineer; or with fuel oil applied by a high pressure fog system.
   2. Cover each load with canvas or other suitable material to protect the mixture from the weather.
   3. Deliver stone at a temperature not exceeding 350°F.

B. Storage and Handling Requirements:
   1. Heating and Storing Asphaltic Paving Mixture Ingredients:
      a. Heat asphaltic cement in approved receptacles to a temperature between 275°F and 350°F.
      b. Keep asphaltic cement uniform in composition and consistency.
      c. Heat aggregate in approved revolving driers.
   2. Hot Asphaltic Mixture Holding Bins:
      a. Store hot asphaltic mixtures at the mixing plant or satellite sites in bins that are currently approved by NYSDOT.
      b. After storage, maintain the mixture as indicated in Table 32 12 00-1.

Table 32 12 00-1 Hot Asphaltic Mixture Storage Requirements

Test Property	Allowable Variation
Temperature	± 20°F from pug mill discharge temperature
Gradation	Within job mix formula tolerance
Asphalt Content	Within job mix formula tolerance
Asphalt Cement Recovered from Mixtures:	
Penetration @ 77°F	Loss not to exceed 50% of the penetration of the asphalt sampled prior to mixing.
Viscosity @ 140°F	Viscosity not to exceed 4 times the viscosity of the asphalt sampled from the plant prior to mixing.

1.7 SITE CONDITIONS

A. Ambient Conditions:
   1. Spread and compact mixtures during daylight.

2. Schedule the placement of asphaltic paving material when the Precipitation Probability from the U.S. Weather Bureau, obtained within 3 hours prior to the start of such operations is less than 50 percent.
   a. Notify the Engineer of the exact time at which the above information was obtained.
3. Do not lay mixtures in wet weather.
4. Do not lay permanent asphaltic mixtures when surface temperatures are below those listed in Table 32 12 00-2:

Table 32 12 00-2 Minimum Surface Temperatures for Laying	
Compacted Lift Thickness	Minimum Surface Temperature
3 inches or greater	40° F
Between 1 inch and 3 inches	45° F
1 inch or less	50° F

   a. Take surface temperatures at 3 locations in the area being paved.
   b. The controlling temperature are the average of the 3 readings.
5. Temporary pavements are not subject to the above requirements, but must be placed as approved by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Asphalt Cement:
   1. Furnish viscosity grade AC-20 asphalt cement complying with the requirements specified for material designation 702-03 in Section 702 of the NYSDOT Standard Specifications, and with the requirements specified for Penetration Grade 60-70 specified in ANSI/ASTM D946.

B. Coarse Aggregates:
   1. Furnish coarse aggregates complying with the requirements specified in ASTM D692 as amended or supplemented by the requirements specified in Section 401-2.02 of the NYSDOT Standard Specifications.
   2. Furnish coarse aggregates having the gradation specified in Table 32 12 00-1.

C. Mineral Filler:
   1. Furnish finely divided mineral matter, such as rock dust, hydrated lime, hydraulic cement, fly ash, loess, or another material as determined and approved by the Engineer.
   2. Furnish mineral filler sufficiently dry to flow freely and essentially free from agglomerations, organic impurities, and other objectionable materials.

D. Sand:
   1. Conform to the requirements for fine aggregate in ASTM D-1073 and as amended or supplemented by Section 401-2.02 of the NYSDOT Standard Specification.

E. Aggregate Base:
1. Conform to NYSDOT Standard Specifications Section 304, Type 2.

F. Wood Header:
1. Preservative: Wolman CCA Type C in accordance with AWPA Standard P5.
2. Pressure treated to conform to AWPA Standard C1 and C14.

2.2 MIXES

A. Asphaltic Paving Mixture:
1. Provide a bituminous plant mix composed of a mixture of aggregate, filler and bituminous material.
   a. Thoroughly coat the aggregate with asphaltic cement.
2. Provide a bituminous plant mix complying with the requirements indicated in Table 32 12 00-2.

Table 32 12 00-2 Plant Mix Composition

Use	Asphaltic Binder		Asphaltic Surface Course	
Screen Sizes	General Limits % Passing	Job Mix Tolerance %	General Limits % Passing	Job Mix Tolerance %
1-1/2-inch	100	-		-
1-inch	95-100	-	100	-
1/2-inch	70-90	±6	95-100	±7
1/4-inch	48-74	±7	65-84	±7
1/8-inch	32-62	±7	30-65	±7
No. 20	15-39	±7	15-39	±7
No. 40	8-27	±7	8-27	±4

Table 32 12 00-2 Plant Mix Composition

Use	Asphaltic Binder		Asphaltic Surface Course	
Screen Sizes	General Limits % Passing	Job Mix Tolerance %	General Limits % Passing	Job Mix Tolerance %
No. 80	4-16	±7	4-16	±2

No. 200	2-8	±7	2-6	±2
Asphalt Content %	4.5-6.5±0.4		5.8-7.0±0.4	
Mixing and Placing Temperature Range °F	250°-325°		250°-325°	

3. Base aggregate tolerances on the total weight of the aggregate and the bitumen tolerances on the total weight of the mix.

2.3 SOURCE QUALITY CONTROL

A. Tests:
1. Gradation Test:
a. Test Procedure:
i. Have the Testing Laboratory perform Gradation Tests in accordance with the method specified in ASTM D546.
b. Acceptance Criteria:
i. Coarse aggregate and mineral filler meeting the gradation requirements indicated in Table 32 12 00-1 pass the Gradation Test.

Table 32 12 00-1 Coarse Aggregate and Mineral Filler Gradation	
Sieve Size	Percent Passing (by Weight)
No. 30	100
No. 80	85-100
No. 200	65-100

B. Non-Conforming Work:
1. Do not furnish coarse aggregate and mineral filler that fail the Gradation Tests.

PART 3 - PRODUCTS

3.1 PREPARATION

A. Ensure substrates are in suitable condition to receive the work.
1. Design builder shall clean all existing joints/cracks of all deleterious material in accordance to NYSDOT Section 633, Conditioning Existing Pavement.

2. Design builder shall seal all existing cracks with a joint and crack filler prior to asphalt overlay in accordance to NYSDOT Section 633, Conditioning Existing Pavement and NYSDOT Section 702, Materials and Manufacturing.
3. Design builder shall mill/grind a minimum 3'x3' area of existing asphalt pavement to a depth of 1½" below existing manhole cover elevations at locations where rims are flush with existing pavement prior to asphalt overlay installation.
4. Design builder shall mechanically sweep pavements surfaces immediately prior to commencement of asphalt overlay installation.

B. Protection of In-Place Conditions:
1. Temporary Pavement:
a. Furnish and lay temporary pavement wherever required to properly maintain traffic over backfilled trenches and at such other locations as may be directed by the Engineer.
b. Temporary pavement shall consist of asphaltic binder mixtures, laid to adequate thickness and compaction.

3.2 INSTALLATION

A. Equipment:
1. Mixing Plants:
a. Furnish mixing plants approved by NYSDOT for use in NYSDOT construction.
b. Ensure that the plant and plant operations are in accordance with the requirements of Section 401-3.01 "Quality Control" of the NYSDOT Standard Specifications.
2. Asphaltic Pavers:
a. Furnish self-power pavers having an activated screed or strike-off assembly capable of spreading and finishing courses in widths approved by the Engineer.
b. Furnish pavers capable of spreading and finishing narrow widths of pavement.
c. Furnish pavers equipped with a receiving hopper with sufficient capacity for uniform spreading operation and automatic flow controls.
d. Furnish pavers having a heated screed or strike-off assembly to produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.
e. Furnish pavers equipped with approved automatic transverse slope and longitudinal grade screed controls to automatically adjust the screed and increase or decrease the mat thickness to compensate for irregularities in the surface being paved.
i. Provide controls capable of maintaining the proper transverse slope and readily adjustable for transitions.
3. Rollers:
a. Furnish tandem type power driven rollers capable of providing a pressure not less than 225 pounds per inch width of the main roll.
i. Furnish smooth true rolls without flat spots or other imperfections.
b. Furnish self-propelled, pneumatic rubber-tired rollers with wheels mounted, grouped, and spaced to provide uniform coverage with each pass.
i. Furnish rollers with rear group wheels that do not follow in the tracks of forward group wheel.
ii. Furnish rollers with a maximum wheel load of 5600 pounds.
iii. Furnish rollers with a tire compression on pavement, where the area of contact is measured on a hard, unyielding surface, of 80 psi, plus or minus 5 psi, for each wheel; and having a total maximum load per axle, whether single axle or a group of axles in the same alignment, of 22,400 pounds.

iv. Control wheel loads and tire pressures to produce the required degree of compaction without rutting of the surface to be rolled.

B. Headers:
1. Install wood headers where indicated. Brace headers to support ballast until paving is installed.

C. Placing:
1. Place surface courses and binders over aggregate base using an approved mechanical spreader.
   a. Keep the number of longitudinal joints to a minimum.
   b. Limit hand placement of asphaltic material to those areas where machine spreading and finishing is not practical.
2. Ensure the temperature and consistency of the mix at time of application comply with the specified requirements.

D. Spreading:
1. Do not allow the asphaltic mixture to be placed in a continuous strip exceeding 800 feet long.
2. Lay adjacent strips immediately after each previous strip is placed until the full width of the roadway surface has been covered.

E. Binder Mixture:
1. Using an asphaltic paver, lay the binder mixture to a depth which after final compaction is equal to the specified depth.
   a. In areas where the use of the paver is impractical, as determined by the Engineer, other approved means of spreading and compaction may be permitted.
2. Hand Laying Binder Mixture:
   a. Uniformly spread binder mixture using hot iron rakes with tines not less than 1/2 inch longer than the loose depth of the mixture, or using a mechanical spreader, to a depth which, after final compaction, is equal to the specified depth.
   b. Thoroughly compact the binder mixture using approved tamping irons adjacent to curbs, manholes, rails, and similar structures; and with approved rollers to a surface that is parallel to and below the finished grade and crown of the finished surface.
   c. If the binder mixture breaks up, shows lack of bond, or other defects before the surface mixture is laid, take it up, and remove and replace it with suitable material at no increase in the Contract Price.

F. Surface Course Mixture:
1. Before the surface mixture is laid, paint the contact surfaces of curbs, gutters, headers, and manholes with a thin uniform coating of approved hot asphaltic cement, liquid asphalt, or emulsified asphalt.
2. Using an asphaltic paver, lay the surface course mixture to a depth which after final compaction is equal to the specified depth.
   a. In areas where the use of the paver or mechanical spreader is impractical, other approved means of spreading and compaction may be permitted.
3. Hand Laying Surface Mixture:
   a. Uniformly spread surface course mixture using hot iron rakes with tines not less than 1/2 inch longer than the loose depth of the mixture to a depth which, after final compaction, is equal to the specified depth.
   b. No walking will be permitted on the surface mixture during the laying operations.
   c. After spreading and raking the surface mixture, carefully lute surface course mixture from the sides before compaction.

G. Compaction:
1. Rolling:
a. Proceed rolling continuously at the following rates:
i. For binder, base course, and drainage medium mixtures, when spread by hand, not in excess of 400 square yards per hour per roller.
ii. For binder, base course, and drainage medium mixtures, when spread by machine, not in excess of 600 square yards per hour, per roller.
iii. For asphaltic concrete surface mixtures, when spread by hand, not in excess of 300 square yards per hour per roller.
iv. For asphaltic concrete surface mixtures, when spread by machine, not in excess of 400 square yards per hour per roller.
b. Immediately after spreading the mixture, using approved tamping irons thoroughly compact the mixture adjacent to curbs, manholes, and rails; and by rolling using approved rollers continuously from commencement to final completion at a speed not exceeding 3 mph.
c. Make the initial rolling using steel-wheeled, power-driven, tandem type rollers parallel to the center line of the paved surface beginning at the curbs or edges of the paved surface and working toward the center, overlapping on successive trips by one-half the rear wheel of the roller.
d. Immediately following the initial rolling, further compact the mixture by using pneumatic rubber-tired rollers for a minimum of eight passes.
i. Smooth shallow ruts and ridges with tandem rollers immediately following the rubber-tired rolling.
2. Final Roll:
a. Continue rolling until no further compression results; the mixture has cooled; no marks show under the roller; and the surface is smooth and free from depressions, waves, bunches and unevenness.
b. After the mixture has been rolled, test the surface with an approved straight edge and surface testing machine laid parallel to the center line of the paved surface.
3. Vibratory Compaction:
a. When permitted by the Engineer, use vibratory compaction in accordance with Section 402-3.07 "Option 2" of NYSDOT Standard Specifications and Section 402-3.04 "Rollers" of NYSDOT Standard Specifications.
b. Compaction testing requirements are to conform to NYSDOT Standard Specifications Section 402-3.07.

H. Joints:
1. Lay the surface mixture in a continuous operation, and pass the roller over the unprotected end of the freshly laid mixture only when the lying of the course is to be discontinued for such length of time as to permit the mixture to become chilled.
a. Provide for a proper bond with the new mixture by cutting or trimming back the joint to expose an unsealed or granular surface for the full-specified depth of the course.
2. At the end of each day's work, form joints by laying and rolling against boards of the thickness of the compacted mixture, placed across the entire width of the pavement.
3. When the laying of the mixture is resumed, paint the exposed edge of the joint with a thin coat of approved hot asphaltic cement or liquid asphalt, rake a fresh mixture against the joint, thoroughly tamp and roll.
4. Hot smoothing irons may be used for sealing joints.

3.3 SITE QUALITY CONTROL

A. Site Tests:
   1. Test final density and smoothness after rolling and before acceptance.
   2. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
   3. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
   4. In-place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to AASHTO T 168.
      a. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job- mix specifications.
      b. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM 2726.
         i. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
         ii. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
   5. Replace and compact hot-mix asphalt where core tests were taken.
   6. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

B. Non-Conforming Work:
   1. Portions of the completed wearing course that are defective in finish, compression, composition or density, shall be taken up, removed and replaced with suitable material properly laid in accordance with these specifications.

3.4 PROTECTION

A. Traffic:
   1. No traffic of any kind will be allowed on the pavement until permitted by the Engineer.

END OF SECTION

Attachment - Purdy's Station Existing French Drain Photo

SECTION 04 22 00 - CONCRETE MASONRY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. 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. Concrete masonry units
2. Decorative concrete masonry units.
3. Ground Face with Loose Fill Insulation
4. Mortar and grout.
5. Steel reinforcing bars.
6. Masonry-joint reinforcement.
7. Embedded flashing.
8. Miscellaneous masonry accessories.
9. Masonry-cell fill.

B. Related Requirements:
1. Section 05 10 00 "Structural Metal Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
2. Section 05 50 00 “Metal Fabrication”
3. Section 07 60 00 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
4. Section 09 96 23 “Graffiti resistance coatings”

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

Addendum 6

B. Shop Drawings: For the following:
1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315

C. Samples for Initial Selection:
1. Decorative CMUs, in the form of small-scale units.
2. Colored mortar.
3. Weep holes/vents.

D. Samples for Verification: For each type and color of the following:
1. Decorative CMUs.
2. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:
1. Masonry units.
a. Include data on material properties
2. Integral water repellant used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar. 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/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

Addendum 6

B. 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 panels for typical exterior wall in sizes approximately 48 inches long by 36 inches high
2. Build sample panels facing south.
3. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
    a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Protect accepted mockups from the elements with weather-resistant membrane.
2. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
    a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
    b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 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. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD 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.

Addendum 6

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
   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.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.

Addendum 6

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
   1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction

2.3 CONCRETE MASONRY UNITS

A. Regional Materials: CMUs shall be manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide square-edged units for outside corners unless otherwise indicated.

C. Integral Water Repellent: Provide units made with integral water repellent where indicated.
   1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514/E 514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

D. CMUs: ASTM C 90.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi
   2. Density Classification: Normal weight unless otherwise indicated.
   3. Size 8”: Manufactured to dimensions 3/8 inch less than nominal dimensions.
   4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

E. Decorative CMUs: ASTM C 90.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi
   2. Density Classification: Medium weight
   3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
   4. Pattern and Texture:
      a. Standard pattern, ground-face finish
      b. Match Architect's samples.
   5. Colors: As selected by Architect from manufacturer's full range

Addendum 6

2.4 MASONRY LINTELS

A. General: Provide one of the following:

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.5 MORTAR AND GROUT MATERIALS

A. Regional Materials: Aggregate for mortar and grout shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Masonry Cement: ASTM C 91/C 91M.
1. EssRoc
2. Lafarge
3. Holcim

C. Colored Cement Products: Packaged blend made from masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Colored Masonry Cement:
   a. EssRoc
   b. Lafarge
   c. Holcim
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 5 percent of masonry cement by weight.

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.

2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60

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B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to 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.

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A 951/A 951M.
1. Exterior Walls: Hot-dip galvanized carbon steel.
2. Wire Size for Side Rods: 0.148-inch diameter.
3. Wire Size for Cross Rods: 0.148-inch diameter.
4. Spacing of Cross Rods: Not more than 16 inches o.c.
5. Provide in lengths of not less than 10 feet

2.7 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

B. 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 Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. 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, hot-dip galvanized steel wire
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch diameter, hot-dip galvanized steel wire.

D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Corrugated-Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 made from 0.060-inch- thick steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete.

E. Partition Top Anchors: 0.105-inch- thick metal plate with a 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M

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

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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 felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

2.9 MASONRY-CELL FILL

A. Loose-Fill Insulation: Perlite complying with ASTM C 549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

B. Lightweight-Aggregate Fill: ASTM C 331/C 331M.

2.10 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 masonry cement 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 masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S
3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Pigmented Mortar: Use colored cement product
1. Pigments shall not exceed 5 percent of masonry cement by weight.
2. Mix to match Architect's sample.
3. Application: Use pigmented mortar for exposed mortar joints with the following units:
a. Decorative CMUs.

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.

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1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

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 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.

7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

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 stepping 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.

F. 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.

G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above. 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.

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3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs 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. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Wet joint surfaces thoroughly before applying mortar.
3. Rake out mortar joints for pointing with sealant.

D. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch (6 mm) and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.

E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

F. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

G. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-CELL FILL

A. Pour loose-fill insulation into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than 20 feet.

B. Install molded-polystyrene insulation units into masonry unit cells before laying units.

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3.7 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at corners by using prefabricated L-shaped units.

D. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 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.

3.9 LINTELS

A. Provide **masonry** lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FLASHING

A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall 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
   2. At lintels, 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.

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3. 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.
4. Install metal drip edges 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.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

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 comply with specified requirements shall be done at Contractor's expense.

B. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

C. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

D. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength

E. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

F. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days.

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.

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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. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

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.

B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

Addendum 6

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. 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. Extruded polystyrene foam-plastic board.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.4 SUBMITTALS:

A. Submit in accordance with Division 1 Submittals

B. Manufacturer's Literature and Data:
   1. Insulation, each type
   2. Fastening requirements

C. Certificates:
   1. Indicating type, thickness and thermal conductance of insulation. (Average thickness for tapered insulation).

D. Laboratory Test Reports: Thermal values of insulation products.

1.5 QUALITY ASSURANCE:

A. Insulation shall be approved for local use.

B. Source Limitation: Obtain each type of roof insulation through one source.

C. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:
1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

B. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Dow Chemical Company (The).
   b. DiversiFoam Products.
   c. Owens Corning.
   d. Pactiv Corporation.
   e. Or, Engineer’s Approved Equal
2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

C. Extruded Polystyrene Board, Type VI (roof): ASTM C 578, Type VI, 40-psi minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Dow Chemical Company (The).
   b. DiversiFoam Products.
   c. Owens Corning.

d. Pactiv Corporation.
e. Soprema, Inc.
f. or, Engineer's Approved Equal

D. POLYISOCYANURATE INSULATION

A. Polyisocyanurate Board Insulation for Exposed Conditions: ASTM C 1289, Type I, Class 1, tested to comply with FM 4880.

1. Basis-of-Design Manufacturer / Product: Dow THERMAX White Finish (WF), or an Architect acceptable equivalent.
2. Physical Properties:
   a. Compressive Strength, ASTM D1621: 25.0 psi, min.
   b. Flexural Strength, ASTM C203: 40.0 psi, min.
   c. Water Vapor Permeance, ASTM E96: 0.03 perms, max.
   d. Maximum Use Temperature: 250°F
3. Face Finish: Faced with nominal 1.25 mil embossed white acrylic coated aluminum on one side and 0.9 mil smooth aluminum on the other.
4. Furnish adhesives, joint tapes, and joint closure systems as recommended by manufacturer.

2.2 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. AGM Industries, Inc.
   a. Gemco.
   b. Or, Engineer's Approved Equal.
3. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
4. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.

B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Manufacturers: Subject to compliance with requirements, provide products by the following::
   a. Gemco.
   b. Or, Engineer's Approved Equal.
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.

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. Manufacturers: Subject to compliance with requirements, provide products by the following::
   a. AGM Industries, Inc.
   b. Gemco.
   c. Or, Engineer's Approved Equal.
2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
3. Crawl spaces.
   a. Ceiling plenums.
   b. Attic spaces.

D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch between face of insulation and substrate to which anchor is attached.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Gemco.
      b. Or, Engineer's Approved Equal.

E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following::
      a. AGM Industries, Inc.
      b. Gemco.
      c. Or, Engineer's Approved Equal.

2.3 ACCESSORIES

A. Insulation for Miscellaneous Voids:
   1. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

B. Asphalt Coating for Cellular-Glass Block Insulation: Cutback asphalt or asphalt emulsion of type recommended by manufacturer of cellular-glass block insulation.

C. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

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. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

END OF SECTION

SECTION 07 41 13 - METAL ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 1 General Requirements

B. Section 05 50 00 Metal Fabrications

C. Section 07 62 00 Sheet Metal Flashing and Trim

1.2 SUMMARY

A. Prefinished, prefabricated structural standing seam roof system with continuous interlocking field formed seams.

B. Coordinated hip, gable, and valley flashings, ridge and peak caps, eave and shelf drips, and counter flashings.

C. Clips, fasteners, closures, and sealants as necessary to meet design criteria and ensure weathertight installation.

1.3 REFERENCES

A. Aluminum Association: 2005 edition of the Aluminum Design Guide

B. American Society for Testing and Materials (ASTM): ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

C. ASTM E1680 Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.

D. ASTM E1646 Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.

E. ASTM E1592 Standard Test Method for Structural Performance of SheetMetal Roof and Siding Systems by Uniform Static Air Pressure Difference.

F. Factory Mutual Global Group: FM 4471, August 1995: Approval Standard for Class 1 Panel Roofs

G. ASTM A 446 - Structural physical quality of galvanized steel sheet.

H. SMACNA - Architectural sheet metal manual.

I. NRCA - Architectural sheet metal manual.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Design Requirements:
1. Product to be listed as Energy Star qualified.
2. Design criteria shall be in accordance with current edition of the New York State Building Code.
3. Dead Load:
   a. The dead load shall be the weight of the structural standing seam roof system.
4. Live Load
   a. The roof panel and concealed clips shall be capable of supporting a minimum uniform live load of 30 psf or as noted on structural drawings.
5. Snow Loads:
   a. The roof snow load shall be as shown on the Contract Drawings.
   b. Snow drift effects shall be taken into consideration as applicable.
6. Wind Loads:
   a. Wind loads shall be as shown on the Contract Drawings or calculated per Building Code components/cladding criteria. The greater uplift pressure (Contract drawing specified or Building Code calculated) shall govern.
7. Thermal Loads:
   a. Roof panels shall be free to expand/contract resulting from a total temperature differential of 150 degrees F.

B. Structural Requirements:
1. Panel structural properties are to be determined in accordance with latest edition of Aluminum Association's "Aluminum Design Manual- Specifications and Guidelines for Aluminum Structures".
2. Metal roof system must be tested in accordance with ASTM E-1592 "Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference" for determination of negative (uplift) load capacity.

C. Environmental Requirements:
1. Resistance to air infiltration: Maximum of .024 cfm per square foot when tested in accordance with ASTM E 1680 at static test pressure differential of 6.24 psf.
2. Resistance to water infiltration: No leakage through panel joints when tested in accordance with ASTM E 1648 at static test pressure differential of 12 psf.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
1. Documented successful experience in fabrication of standing seam roofs. Manufacturer shall demonstrate past experience with examples of projects of similar type and exposure.
2. Manufacturer to be registered with a Program Operator with a Certified, Environmental Product Declaration, in conformance with ISO 14025, for Insulated Metal Panels.

B. Installer Qualifications:
1. Experienced in the application of structural field-formed concealed clip roofing systems
2. Applicator must be an approved installer, certified by the manufacturer prior to beginning installation of the standing seam roof.

C. Pre-Installation Meetings:

1. Conduct pre-installation meeting with Owner, Engineer, Installer, Manufacturer's Technical Representative, and Design Builders of related trades to verify project requirements, substrate conditions, and manufacturer's installation instructions.

1.6 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's specifications, standard details, and installation manual.
   1. Test Reports or current product listing on energystar.gov: For insulated metal roof panels, indicating that panels comply with Solar Reflectance Index (SRI) requirement
   2. Energy Analysis: Demonstrating percentage of performance improvement compared with the baseline building performance rating
   3. Product Certificates: Documenting compliance with minimum recycled content, indicating percentages by weight of postconsumer and pre- consumer recycled content.
   4. Product Certificates: Documenting compliance with requirements for regionally manufactured materials. Include statement indicating cost, location of manufacturer, and distance to Project.

C. Shop Drawings:
   1. Show roof panel system with flashings and accessories in plan and elevation; sections and details. Include metal thicknesses and finishes, panel lengths, joining details, anchorage details, flashings and special fabrication provisions for termination and penetrations. Indicate relationships with adjacent and interfacing work.
   2. Do not proceed with manufacture of roofing materials prior to review of shop drawings and field verification of all dimensions.

D. Samples:
   1. Submit sample of panel section, 12" long x full width panel, showing proposed metal gauge, finish and seam profile.
   2. Submit sample of panel clip and gable clip.

E. Test Reports:
   1. Submit copies of design test reports for each of the performance testing standards listed in Section 1.03 of this specification.
   2. Test reports shall be performed by an independent, accredited testing laboratory, and shall bear the seal of a registered professional engineer.

F. Calculations:
   1. Submit engineering calculations defining cladding loads for all roof areas based on design criteria listed in section 1.03 of this specification.
   2. Calculation shall clearly indicate clip type, spacing of clips by roof zones, and fastener requirements.
   3. Uplift load capacity of roof panel system shall be determined by ASTM E- 1592 testing. Extrapolation of uplift capacities is not acceptable. Uplift capacity calculation by "section property" method is not acceptable.
   4. Compute uplift loads on clip fasteners with recognition of prying forces and eccentric clip loading.

5. Calculate pullout/shear strength of fasteners in accordance with test data published by the fastener manufacturer, utilizing applicable material safety factors.
6. Compute thermal calculation for expansion/contraction forces due to total temperature differential of 150 degrees F.
7. Compute panel fixed point attachment forces and required fasteners.
8. Compute in-plane clip forces and indicate required attachment fasteners.

G. Warranty:
1. Furnish manufacturer's standard 20-year warranty stating panel material and finish will not fail due to:
   a. Corrosion
   b. Rupture
   c. Perforation
   d. Peeling or Flaking Finish
2. Furnish written warranty issued by Manufacturer and signed by Installer for two year period from date of substantial completion of the building covering repairs required to maintain roof and flashings in watertight conditions.

H. Certification:
1. Submit manufacturer's certification that materials and finishes meet specification requirements.
2. Submit applicator's certification that installer of products meets specified qualifications

1.7 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 3.2.

B. DELIVERY:
1. Schedule delivery of materials at the site at such time as required for proper coordination of the work. Receive materials inmanufacture's unopened packages and bearing manufacturer's label.

C. STORAGE AND HANDLING:
1. Store materials in a dry and well ventilated place, adequately protected from damage and exposure to the elements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers:
1. Kingspan
2. MBCI
3. Metl-Span
4. Approved equal

B. Panels:
1. Color: Must be ght Gray.

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2. Aluminum alloy sheet, ASTM B209, aluminum alloy 3004 in accordance with manufacturer's standard to suit forming operations and finish specified
3. Thickness as specified or recommended.
4. Fabricated vertical leg standing seam panel with integral continuous overlapping seams suitable for continuous zipping or crimping by mechanical means during installation.
5. Panel seam design shall allow for mechanical "unzipping" without compromise of panel structural integrity.
6. Panels shall be 15.75" wide (400mm) with a minimum vertical standing leg height of 2 ½".

C. Clip/Fastener Assemblies:
1. "ST" Clip:
   a. 0.09" min. thick extruded Aluminum clip designed to freely accommodate thermal movement for panel lengths up to 130 ft.
2. "E" Clip:
   a. One piece reinforced polyamide clip designed to freely accommodate thermal movement for panel lengths beyond 130 ft.

D. Accessories:
1. Provide manufacturer's standard accessories and other items essential to completeness of standing seam roof installation.
2. Provide non-penetrating snow guards installed per manufacturer's specifications.

E. Sealants: Use only high quality sealants as recommended or approved by the roof system manufacturer. Sealants must not contain oils, asbestos, or asphalts.
1. Non-Curing Butyl: One-part, non-skinning, non-drying, synthetic butyl elastomer. Use for metal-to-metal sealing or bedding of panel and flashing seams or joints.
2. Butyl Tape (Webbed Mastic): Extruded polymeric butyl tape, non-skinning and not easily displaced under compression. Use for critical sealing of panel ends, endlaps, penetrations, closures, and flashings
3. Urethane: One-part moisture curing, gun grade polyurethane sealant. Used for sealing in all exposed conditions.

2.2 MISCELLANEOUS MATERIALS

A. Fasteners:
1. All self tapping/self drilling fasteners, bolts, nuts, rivets shall be designed to withstand specified design loads.
2. All fasteners to be manufactured from series 304 austenitic stainless steel. Rivet style fasteners to be manufactured from aluminum or stainless steel.
3. Provide neoprene washers under the heads of all exposed fasteners.
4. Use proper torque settings to obtain controlled uniform compression for a positive seal without rupturing the neoprene washer.

B. Accessories:
1. Provide all components required per the approved shop drawings for a complete metal roof system to include panels, clips, gable clips, fasteners, trims/flashings, closures, fillers, sealants and any other required items.

2.3 FABRICATION

A. Panels:
   1. Provide factory formed panel widths of 15.75” with 2.5" high standing seam.
   2. Panels are to be fabricated full length with absolutely no end lap conditions allowed.

B. Trim/Flashing:
   1. Fabricate trims/flashings from same material and gauge as roof panel system.
   2. Fabricate trims/flashings in accordance with approved shop drawings and applicable standards.

2.4 FINISH

A. Painted Aluminum:
   1. Two-Coat Fluoropolymer Finish: Standard fluoropolymer 2-coat system consisting of 0.2 mil primer and 0.8 mil 70 percent PVDF fluoropolymer color coat.
      a. Color: Light Gray. Must provide a minimum SRI of 78 at low-sloped roof (<2:12) and a minimum SRI of 29 for steep-sloped roof locations (>2:12).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the alignment and placement of the building structure and substrate. Correct any objectionable warp, waves or buckles in the substrate before proceeding with installation of the pre-formed metal roofing. The installed roof panels will follow the contour of the structure and may appear irregular if not corrected.

B. Do not proceed with installation until discrepancies have been resolved.

3.2 DELIVERY, STORAGE AND HANDLING

A. Delivery:
   1. Deliver metal roof system to jobsite properly packaged to provide protection against transportation damage

B. Handling:
   1. Exercise extreme care in unloading, storing, and erecting metal roof system to prevent bending, warping, twisting, and surface damage.

C. Storage And Protection:
   1. Store sheet bundles above ground with one end elevated and allow for air circulation and drainage.
   2. Store sheet bundles under tarpaulin cover to protect from rain and prevent accumulation of dirt and condensation.

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3. When storing on roof, ensure that the load bearing capacity of the substructure is sufficient. Secure sheets and packages against wind uplift and sliding.
4. Prolonged storage of bundled sheets is not recommended.
5. ALWAYS avoid direct contact with alkali-bearing material such as lime based cement, concrete/mortar.

D. Delivery:
1. Deliver metal roof system to jobsite properly packaged to provide protection against transportation damage.

E. Handling:
1. Exercise extreme care in unloading, storing, and erecting metal roof system to prevent bending, warping, twisting, and surface damage.

F. Storage And Protection:
1. Store sheet bundles above ground with one end elevated and allow for air circulation and drainage.
2. Store sheet bundles under tarpaulin cover to protect from rain and prevent accumulation of dirt and condensation.
3. When storing on roof, ensure that the load bearing capacity of the substructure is sufficient. Secure sheets and packages against wind uplift and sliding.
4. Prolonged storage of bundled sheets is not recommended.
5. ALWAYS avoid direct contact with alkali-bearing material such as lime based cement, concrete/mortar.

3.3 INSTALLATION

A. Install roofing and flashings in accordance with approved shop drawings and manufacturer's product data, within specified erection tolerances.

B. Install metal roof system so that it is weathertight, so that it is without waves, warps, buckles, fastener stresses or distortion.

C. Install metal roof system with allowance for thermal expansion andcontraction.

D. Anchor roof panels securely in place using clips and fasteners spaced in accordance with manufacturer’s recommendations.

E. Do not allow panels or trim to come in contact with dissimilar materials suchas copper, fire retardant treated timber, concrete/mortar. Water runoff from dissimilar materials is also prohibited.

3.4 CLEANING

A. Clean exposed surfaces of excess material and debris promptly after completion of installation.

B. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.

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3.5 PROTECTION

A. Protect work as required to ensure roofing will be without damage at time of final completion.

B. Replace products having damage other than minor finish damage.

C. Repair products having minor damage to finish in accordance with panel manufacturer's recommendations.

END OF SECTION

SECTION 07 42 93 – SOFFIT PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 1 General Requirements

1.2 SUMMARY

A. Metal soffit panels at all building roof Elevated Tower and Pedestrian Bridge.

1.3 REFERENCES

A. ASTM D 523 – Standard Test Method for Specular Gloss

B. ASTM D 3363 – Standard Test Method for Film Hardness by Pencil Test

C. ASTM D 4145 – Standard Test Method for Coating Flexibility of Prepainted Sheet

D. ASTM D 2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)

E. ASTM D 2247 – Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity

F. ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus

G. ASTM D 2244-89 – Standard Practice for Calculation of Color Differences from Instrumentally Measured Colored Coordinates

H. ASTM D 4214-07 – Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films

I. ASTM G 154 – Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

J. SMACNA - Architectural sheet metal manual.

K. NRCA - Architectural sheet metal manual.

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1.4 ADMINISTRATIVE REQUIREMENTS

A. Provide factory formed, prefinished, interlocking .032" aluminum soffit panels. System to be installed on exposed horizontal ceiling surfaces as indicated on the drawings.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installer who has had successful experience with installation of the same or similar systems required for the project and other projects of similar size and scope.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

C. Do not modify intended aesthetic effects, as judged solely by Engineer, except with Engineer's approval. If revisions are proposed, submit comprehensive explanatory data to Engineer for review.

1.6 SUBMITTALS

A. Manufacturer's Product Data: Describing performed soffit panels, materials, fabrication and installation. Include catalog cuts of hardware, anchors, fastenings and accessories.
   1. Recycled Content:
      a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
      b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
      c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly byweight.
      d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.
   2. Local/Regional Materials:
      a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
      b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the projectsite.
      c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
      d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weightof each component per unit of product.

B. Submit 6 (six) sets of shop drawings, including layout of soffit panels and details of special and typical conditions and attachment details.

C. Submit manufacturer's standard color samples for Engineer's initial selection of material color.

D. Submit samples showing factory-applied color finish for Engineer's approval for each type of exposed finished required in manufacturer's standard sizes.

E. Certification: By manufacture that products have been pretested and comply with the performance requirements indicated.

F. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty. Factory applied exterior finishes on soffit panels for a period of 20 years after the date of substantial completion.

G. All submittals are to be in accordance with Division 01 – Submittal Procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. Schedule delivery of materials at the site at such time as required for proper coordination of the work. Receive materials in manufacture's unopened packages and bearing manufacturer's label

B. Storage and Handling:
   1. Store materials in a dry and well ventilated place, adequately protected from damage and exposure to the elements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Rollex

B. MM Systems

C. Varco Pruden

D. Approved Equal.

2.2 MATERIALS

A. Type 1:
   1. Basis of design: System 3 Aluminum Soffit, model SYS312 System 3 Solid 12 in. Soffit Panel.

B. Kynar and Metallic Fluoropolymer Coating: Manufacturers standard (2) coat, thermocured, full strength 70 percent "kynar 500" coating consisting of a 0.35 mil corrosion resistant primer and a minimum 0.75 mil dry film thickness with a total minimum dry film thickness of 0.9 mil and 30 percent reflective gloss when tested in accordance with ASTM D 523.

C. Color: As noted on Architectural Drawings.

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E. Fasteners: As recommended by Manufacturer.

F. Accessories: Provide manufacturers standard and accessories as required for the complete installation including trim, stops, flashing, corner unit, clips, seam closures, gutters and other related items as required.

G. Sealants: Manufacturer recommended.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that all soffit surfaces are smooth, sound, and free of depressions, waves or any other imperfections.

B. Installer shall examine all substrates on which work is to be applied. Any surface not suitable for application of soffit panel shall be conveyed in writing to the Engineer.

3.2 INSTALLATION

A. Comply with panel manufacturer's instructions for anchorage, joint sealers, flashing, and trim for the proper and permanent installation of panels, with provisions for thermal expansion, erected in panel pattern indicated.

END OF SECTION

SECTION 08 80 00 – GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: The Work of this Section shall include, but not be limited to, glass and glazing for the following:
1. Glass rainscreen wall cladding system, GLS-01.
2. Glass wall elevator enclosure system, GLS-1A.
3. Aluminum and glass barrier (windscreen) system for elevator entrance, GLS-02.
4. Glass awning system for elevator entrance, GLS-03.
5. Elevator cab, GLS-04.

1.2 SYSTEM DESCRIPTION

A. Provide glass and glazing that will withstand normal thermal movement, wind loading and impact loading (where applicable), without failure of glass, failure of gaskets to remain watertight and airtight, nor deterioration of glass and glazing materials.
1. Normal thermal movement is defined as that resulting from an ambient temperature range of 120 degrees F and from a temperature range within glass and glass framing members of 180 degrees F.
2. Deterioration of insulating glass is defined as failure of hermetic seal due to other causes than breakage which results in intrusion of dirt or moisture, internal condensation or fogging, resulting from seal failure, and any other visual evidence.
3. Deterioration of coated glass is defined as the development of manufacturing defects including peeling, cracking or other indications of deterioration in coating due to normal use.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions. Indicate glass thickness to be used.
1. Submit glass manufacturer's wind pressure analyses and thermal stress analysis; glass manufacturer's review of glazing systems Shop Drawings stating that glazing details are suitable.
2. Submit glass types and identification of glazing materials. Submit insulating glass unit certification.

B. Samples: Submit 12-inch square samples of each type of glass indicated, and 12-inch long samples of each color of gasket.

C. Certificates: Submit certificates from respective manufacturers attesting that glass and glazing materials furnished for Project comply with requirements of agencies having jurisdiction.
   1. Separate certification will not be required for glazing materials bearing manufacturer's permanent labels that represent a quality control program of a certification agency or independent testing laboratory acceptable to authorities having jurisdiction.

D. Compatibility and Adhesion Test Report: Submit statement from sealant manufacturer that glass and glazing materials have been tested for compatibility and adhesion with glazing sealants and interpreting test results, with recommendations for primers and substrate preparation.

1.4 QUALITY ASSURANCE

A. Glazing Standards: Comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" except where more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined.

B. Safety Glazing Standard: Provide required safety glass which comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for category II materials.

C. Single Source for Glass: To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each kind and condition of glass.

~~D. Insulating Glass Certification Program: Provide insulating glass units permanently marked with appropriate certification label of the Insulating Glass Certification Council (IGCC).~~

~~E. Glazing for Fire-Rated Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.~~

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer's directions and to prevent damage to glass and glazing materials from moisture, temperature changes, and direct exposure to sun, and from other causes.

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with glazing when air and substrate temperatures are outside the limits permitted by glazing material manufacturer or when joint substrates are wet or dirty.

B. During concrete work, provide whatever protection is required to protect for glass and sealant material that has been installed. Replace any materials damaged, as determined by the Commissioner.

1.7 WARRANTY

A. General: Submit warranties to repair or replace defective glass and glazing materials or workmanship for a period of not less than 5 years after date of Substantial Completion, or longer where specified.

B. Insulating Glass: Submit a warranty to replace defective insulating glass for a period of 10 years after date of Substantial Completion. Defects include failure of insulating glass edge seal.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Where float glass is indicated, provide annealed float glass, HS heat- treated float glass, or Kind FT heat-treated float glass**.** Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Primary Glass Standard: Provide primary glass which complies with ASTM C 1036 requirements for type, class and quality.

D. Heat-Treated Glass Standard: Provide heat-treated glass which complies with ASTM C 1048 requirements. Surface compression of heat strengthened glass shall be in the range of 3500 to 6500 psi.
1. Provide heat treated glass where glass would be vulnerable to thermal breakage and where required for safety of persons.
2. Provide fully tempered or heat strengthened glass where indicated or required by authorities having jurisdiction.
   a. Tempered glass shall comply with ANSI Z97.1.

E. Sizes: Fabricate glass to sizes required, with edge clearances and tolerances complying with recommendations of glass manufacturer. Provide thicknesses to comply with Building Code, and as recommended by glass manufacturer, unless greater thickness is indicated.

2.2 PRIMARY GLASS PRODUCTS

A. Clear Float Glass: Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), thickness to meet code requirements.

2.3 HEAT-TREATED GLASS PRODUCTS

A. Uncoated Clear Heat-Treated Float Glass: Condition A, Type 1, Class 1, Quality q3, (glazing select), fully tempered except as noted.

B. Heat Strengthened Glass: Provide heat strengthened glass where required by design wind

pressures or anticipated thermal stress, where fully tempered glass is not required.

C. Tempered Glass: Provide fully tempered glass only where safety glass is mandatory or where design pressures are beyond the capacity of heat strengthened glass. Tempered glass shall be free from inclusions.
   1. Provide tempered glass at entrance doors, vestibule doors and glazed panels, at steel door vision panels.

2.4 COATED GLASS PRODUCTS

A. Low Emissivity Glass: Provide pyrolitically coated clear Low-E glass where indicated, as manufactured by one of the following or equal as approved by the Engineer
   1. Interpane Coatings, Inc.
   2. Libbey Owens Ford Co.
   3. PPG Industries, Inc.
   4. Saint-Gobain.
   5. Spectrum Glass Products, Inc.
   6. SPI Glass Corp.

2.5 LAMINATED GLASS PRODUCTS

A. General: Refer to primary and heat-treated glass requirements for properties of uncoated glasses making up laminated glass.

B. Laminating Process: Fabricate laminated glass using laminator's standard process to produce glass free from defects.

C. Laminated Tempered Glass: ASTM C 1036, ASTM C 1172. Two sheets of double- strength clear sheet glass; Type I, Class 1, quality q3; permanently laminated together with minimum 0.030 inch thick sheet of plasticized polyvinyl butyral, which has been produced specifically for laminating glass.
   1. Kind: LT (laminated tempered), unless otherwise indicated.
   2. Clear Glass: Class 1 (clear).
   3. Thickness: 3/ 8 inch, unless otherwise indicated; but not less than required by structural loads.

D. Interlayer: Interlayer material as indicated below, in translucent white, and of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
   1. Interlayer Material: Polyvinyl butyral sheets.
   2. Products: Subject to compliance with requirements, provide one of the following or equal as approved by the Engineer
      a. Polyvinyl Butyral Interlayer:
         1) Saflex, Monsanto Co.
         2) Butacite, E. I. du Pont de Nemours & Co., Inc.

~~2.6 SEALED INSULATING GLASS UNITS~~

~~A. General: Provide insulating glass units complying with ASTM E 774 and with other requirements specified below, unless otherwise indicated. Provide insulating glass of 1 inch thickness unless otherwise shown.~~

~~1. Insulating glass shall have double edge seals of polyisobutylene and an elastomeric sealant that are continuously bonded to both plates of glass, and compatible with glazing materials.~~

2.7 PATTERNED GLASS

A. Patterned Glass: ASTM C 1036, Type II (patterned glass, flat), Class 1 (clear), Form 3 (patterned), Quality q8 (glazing), Finish f1 (patterned one side); of pattern indicated in the Glass Schedule at the end of Part 3.

2.8 GLAZING GASKETS

A. Dense Gaskets: Extruded one piece gaskets of neoprene, complying with ASTM C 864, of profile required for a watertight seal, with a Shore A hardness of 75 + 5 for hollow profiles and 60 + 5 for solid profiles.

B. Cellular Gaskets: Preformed cellular neoprene gaskets of profile required for a watertight seal; complying with ASTM C 509, with a Shore A hardness of 40 + 5, to provide 20 to 35% compression.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. Compatibility: Provide materials with proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers and Sealers: Type recommended by gasket manufacturer.

C. Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness, 4 inches minimum length by width to suit glass thickness.

D. Shims: Shims used with setting blocks shall be of the same material, hardness, length and width as the setting blocks.

E. Edge Blocks: Same material as setting blocks, of 50-60 Shore A durometer, of size to limit lateral movement of glass.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify compliance with applicable tolerances; for functioning of weep system; for face and edge clearances; and for effective sealing of joinery. Report conditions detrimental to glazing work.

Perform glazing work after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels immediately before glazing. Remove coatings which are not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with recommendations of glass manufacturers, of manufacturers of gaskets and other glazing materials, except where more stringent requirements are indicated by referenced glazing standards.

B. Glazing channels are intended to provide for necessary bite on glass, minimum edge and face clearances, with reasonable tolerances.

C. Protect glass from damage. Remove and dispose of glass units with damage or imperfections of kind that impairs performance or appearance.

3.4 GLAZING

A. Install glass as detailed. Use setting blocks where necessary to prevent movement.

B. Provide edge blocking to comply with referenced glazing standard. Install edge blocks securely, between the midheight and top of glass.

C. Set units of glass in each series with uniformity of appearance.

D. Install sponge and dense gaskets to protrude slightly out of channel, to eliminate dirt and moisture pockets. Provide adequate anchorage to ensure that gaskets will not "walk" out.

3.5 PROTECTION AND CLEANING

A. Promptly protect installed glass from breakage with crossed streamers attached to framing and held away from glass. Do not apply markers on glass. Remove nonpermanent labels and clean glass.

B. Protect glass from contact with contaminating substances. If contaminating substances do come into contact with glass, remove immediately as recommended by glass manufacturer.

C. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

D. Wash glass on both faces not more than 4 days prior to date scheduled for inspections to establish date of Substantial Completion in each area of Project. Wash glass as recommended by glass manufacturer.

3.6 GLAZING SCHEDULE

A. GLS-01: Glass Rainscreen wall cladding system.
   1. One (1) heat-strengthened, laminated, low iron clear glass thickness engineered by rainscreen wall manufacturer and approved by Engineer
   2. Ceramic frit in areas shown in the contract drawings
   3. Hinged as noted on Contract Drawings

B. GLS- 1A: Elevator Hoistway Enclosure
   1. One (1) heat-strengthened, laminated, low iron clear glass thickness engineered by hoistway elevator manufacturer and approved by Engineer
   2. Translucent interlayer
   3. Fire-rated.

C. GLS- 02: Glass barrier (windscreen) for elevator entrance.
   1. One (1) tempered, laminated glass
   2. Frit at back face
   3. thickness engineered by windscreen manufacturer and approved by Engineer

D. GLS- 03: Glass awning for elevator entrance.
   1. One (1) tempered, laminated glass
   2. Frit at back face
   3. thickness engineered by point support fittings awning manufacturer and approved by Engineer

E. GLS- 04: Elevator Cab Doors
   1. One (1): heat-strengthened, laminated, low iron clear glass thickness engineered by elevator cab manufacturer and approved by Engineer

END OF SECTION

Addendum 6

SECTION 09 54 27 - LINEAR WOOD CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to, the following:
   1. Linear wood plank ceilings system.
   2. Required accessories.
   3. Other necessary items including devices for attachments to overhead construction, secondary members, splines, splices, connecting clips, connectors and trims required for a complete installation. Hinge and lock for accessible panels as annotated in drawing set.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Submit shop drawing details of reflected ceiling plans at ¼ inch equals 1 foot scale, unless otherwise indicated; by the installer indicating the following:
   1. Mechanical, electrical and other Work above, penetrating or connected to ceilings.
   2. Indicate framing and support details for Work supported by the suspension system, coordinated with other construction that is concealed, supported, penetrating or adjoining ceilings.
   3. Show grid centering points, dimensioned in relation to walls, columns, locations of lighting fixtures, sprinkler heads, diffusers, registers and other ceiling-mounted work.
   4. Show anchorage to steel structure, bridging and supplementary support, accommodation for built-in and supported items and other data necessary to fabricate, install and coordinate ceiling work with affected trades.
   5. Show method to access areas above ceilings including attachment details, where not otherwise indicated.

C. Samples; Finish System: Two set of planks 24” in length. Each set shall show extremes of the appearance range of exposed finished surfaces, and a mid-range.

D. Certifications: Furnish manufacturer’s certification from an independent testing laboratory acceptable to authorities having jurisdiction that linear plank ceiling units comply with the required fire test performance characteristics.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Installer is to be a firm with not less than five years of successful experience in the installation of specified materials. Submit details of three previous jobs of similar complexity and scope.

B. Regulatory Requirements: Work of this Section shall conform to the Building Code of the New York state.

C. Fire Performance Characteristics: Provide linear wood ceiling components that are identical to those tested for the following fire performance characteristics, according to ASTM test method indicated, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction. Identify linear wood ceiling components with appropriate marking of applicable testing and inspecting agency.
   1. Surface Burning Characteristics: Tested per ASTM E 84.
      a. Flame Spread: 25 or less.
      b. Smoke Developed: 25 or less.

D. Mockups: Prior to fabricating linear wood ceiling panel, construct mock-ups to demonstrate aesthetic effects as well as qualities of materials and execution. Locate mock-ups on-site or in Fabricator's shop as directed by the Commissioner.
   1. A mock-up for each of the following elements shall be constructed of full- size hinge panel of the largest dimensions unless the MNR approves smaller models;
      a. Panel with functioning hinge and lock, complete with metal suspension system and accessories.
   2. Notify the MNR one week in advance of the dates and times when mock- ups will be available for review.
   3. Demonstrate the proposed range of aesthetic effects regarding each element listed under the fabrication heading below.
   4. Mock-up will have finished surface including surface preparation and coat finish.
   5. Obtain Commissioner's approval of mock-ups before starting fabrication of final units.
   6. Retain and maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work.
      a. Approved mock-ups in an undisturbed condition at the time of Substantial completion may become part of the completed work.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver ceiling planks in packages and store them where they will be protected against damage from moisture, frost, direct sunlight, surface contamination or other causes.

B. Store materials in dry and protected locations until installation.

1.5 COORDINATION

A. Coordinate layout and installation of linear wood planks and suspension system components with other construction that penetrates ceilings including louvers, signage, light fixtures and partition assemblies.

PART 2 - PRODUCTS

2.1 LINEAR WOOD CEILING MATERIALS

A. Factory cut ceiling planks of nominal 5/4" X 6" cross section with detail to accept steel attachment clips. Boards factory mounted on panel suspension system as indicated on drawing set, with ½" gaps between boards, with recessed filler strip in gaps.

1. Basis of Design: Linwood III, by Architectural Surfaces, Inc., Chaska, MN, or approved equal.

B. Planks shall be select grade-A solid wood with fire- treatment.
1. Species: Western Red Cedar
2. Panels shall be finished with a clear, two- step sealer and topcoat on front, back, and long sides.
3. Exposed surfaces shall be sanded with 600- grit sandpaper between sealer and finish coat.
4. Finish/ Color: Clear to match MNR's sample.
5. Plank size: 1" thick by 5-1/2" wide actual dimension. Random lengths with no field board less than three feet in length.

C. No fasteners of any kind shall be visible on exposed face surfaces of ceilings or support tees. Openings shall be cut and finished to make a clean and neat appearance as determined by the Engineer.

D. Other system components by manufacturer shall include:
1. Attachment clip for fastening planks to T-grid. Painted metal. Install at frequency recommended by manufacturer for type of use, wind loads and exposure.
2. Leveling spline filler strip - aluminum, matte black.
a. Interior installation: perforated
b. Exterior installation: non-perforated

2.2 METAL SUSPENSION SYSTEMS

A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of materials and finishes indicated that comply with applicable ASTM C 635 requirements. Provide systems that are complete with carriers, splice sections, connector clips, alignment clips, hangers, trim, seismic clips and struts, and other suspension components required to support ceiling units and other ceiling-supported construction.
1. Color: Components shall be painted black as approved by Commissioner.

B. Attachment Devices where used: Size for five times the design load indicated in ASTM C 635, Table 1, Indirect Hung, unless otherwise indicated.

C. Hangers Rods: 1/4 inch diameter mild steel rods, zinc coated or protected with rust- inhibitive paint.

D. Carriers as standard with ceiling system manufacturer.

E. Carrier Splice: Same metal, configuration, and finish as indicated for carriers.

F. Stabilizer Tees and Bars: Manufacturer's standard component for stabilizing type of main carriers and light fixtures indicated, spaced as standard with manufacturer for use indicated, and factory finished with matte-black baked finish.

G. Hold- down Clips, where required: For exterior ceilings, provide hold-down clips spaced as standard with manufacturer.

2.3 ACCESSORIES

A. Edge Moldings and Trim: Metal of type and profile indicated or, if not indicated, molding for edges and penetrations of ceiling that fits with type of edge detail and suspension system indicated.
   1. For circular penetrations of ceiling, provide edge moldings fabricated to diameter and geometry required to fit penetration exactly.

B. Panel hinge and lock: Metal of type and profile indicated or, if not indicated, molding.
   1. For accessible ceiling panels, provide hinge and key-operated lock.

C. Controlled descent cable

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and structural framing to which linear wood ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of linear wood ceilings.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.
   1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

B. Measure each ceiling area and establish layout of linear wood plank units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half-width units at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install linear wood ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
   1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.

B. Suspend ceiling hangers from structural members and as follows:
   1. Install hangers plumb and free from contact with insulation or other objects that are not part of supporting structural or ceiling suspension system.
   2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   3. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for structure to which

hangers are attached and for type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

4. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
5. Do not attach hangers to steel deck tabs.
6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
7. Space hangers not more than 48 inches on center. along each member supported directly from hangers, unless otherwise indicated.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck or steel deck tabs.

D. Install edge moldings and trim of type indicated at perimeter of each linear wood ceiling area and where necessary to conceal edges of units.

1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, level with ceiling system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system carriers so they are aligned and securely interlocked with one another. Remove and replace dented, deformed, or kinked members.

F. Install linear wood plank panels in accordance with manufacturer's instructions, coordinate with suspension system and exposed moldings and trim.

3.4 CLEANING

A. Clean exposed surfaces of linear wood ceilings, including trim and edge moldings.

B. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

C. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and deformed units.

END OF SECTION

Addendum 6

SECTION 10 81 13
BIRD CONTROL DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Installation of control strips, netting, and netting accessories to prevent birds from landing on surfaces as specified herein and on the contract drawings. Refer to Bird Control detail included at the end of this Specification.

1.02 RELATED SECTIONS

A. Section 05 10 00 - Structural Metal Framing

B. Section 05 50 00 - Metal Fabrication

1.03 SUBMITTALS

A. The Contractor shall submit the following information in accordance with the General Provisions:

B. Product Data:
   1. Provide Manufacturers' product literature for materials specified and material Manufacturer's printed directions and recommendations for installation.

C. Samples:
   1. Initial Selection: Submit Manufacturer's custom color for each matching surfaces for approval by the Engineer.
   2. Verification prior to installation.
      a. When required by Engineer, submit sample of each item fastened on a 12" x 12" hardboard.

D. All samples shall be labeled; and include the following information:
   a. Manufacturer's name.
   b. Model Type.
   c. Manufacturer's stock number.
   d. Color for strips: name and number (powder coat custom colors to match the installation surfaces).
   e. Color for netting: refer to Architectural Drawing Finish Schedule
   f. Instructions for installation.

E. All submittals shall comply with the requirements of the General Provisions.

1.04 QUALITY ASSURANCE

A. General**:** Refer to Division 1 Quality assurance

B. Reference standards:
   1. General**:** Refer to Division 1 Reference standards.

C. Obtain all installation information from Manufacturer.

D. Use workers completely familiar with bird control installations.

E. Installer Qualifications: Installer of bird deterrent system is a certified installer with documented history installing manufacturer's products according to manufacturer's specifications.

F. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

1. Protect control strips, netting, and netting accessories from damage before and during installation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Manufacturers:
   1. NIXALITE of America Inc., 1025 16th Avenue, East Moline, IL 61244-1424, Ph: 888-624-1189
   2. Bird-B-Gone, 23918 Skyline, Mission Viejo, California, 92692, Ph: 800-392-6915
   3. Engineer's approved equal.

B. Products:
   1. Model: Pigeon Spike – stainless steel
      a. Basis of design: Nixalite E-Spike
   2. Model: Bird Netting – ½" Polyethylene netting
      a. Basis of design: Nixalite Bird-net

C. Mounting systems
   1. Stainless steel fasteners and hardware as specified by the Manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine work area; note any detrimental conditions that would interfere with proper installation of the bird control.

B. Do not proceed until conditions are corrected.

C. By beginning installation of bird control, contractor is indicating his acceptance of the condition of the work area.

3.02 SURFACE PREPARATION

A. Clean Surface thoroughly before beginning installation. In all installations, the area must be prepared - with the removal of any and all bird droppings, debris, dirt and other foreign matter and the area must be clean of grease, salt and film, loose (flaking) paint, etc.

3.03 INSTALLATION

A. Install in accordance with Manufacturers installation instructions.

B. Strip:
1. Strip must cover the entire depth of surface, not just perimeter. Cut strips to follow all angles and contours closely.
2. Strips must be tangent to the surface, uniform in appearance and have no end-to-end gaps. Refer to the surface Depth charts and specifications in Manufacturer brochures.
3. Where more than one row is needed, the direction of the rows must alternate and clusters of barbs are to be staggered for maximum effectiveness.
4. It is extremely important for strip prongs to be pointed in an "upward" direction. Before installation - holding the product to the installation surface - pre-shape the base strip so it fits the installation surface exactly as you want it to. Then pre-shape the prongs to point in an upward direction. After you are completely satisfied that strip is shaped properly, make the installation.

C. Netting:
1. Features and Components:
   a. 4’ zipper at all Light Fixtures and 2’ zipper at all Equipment.
   b. See architectural drawings for zipper layout.
   c. All clip, turnbuckles and other Hardware to be furnished by manufacturer.

3.04 INSPECTION

A. Visually inspect bird control strips and bird netting for debris. Inspect mounting systems and netting zippers.

PART 4 - COMPENSATION

4.01 **MEASUREMENT**

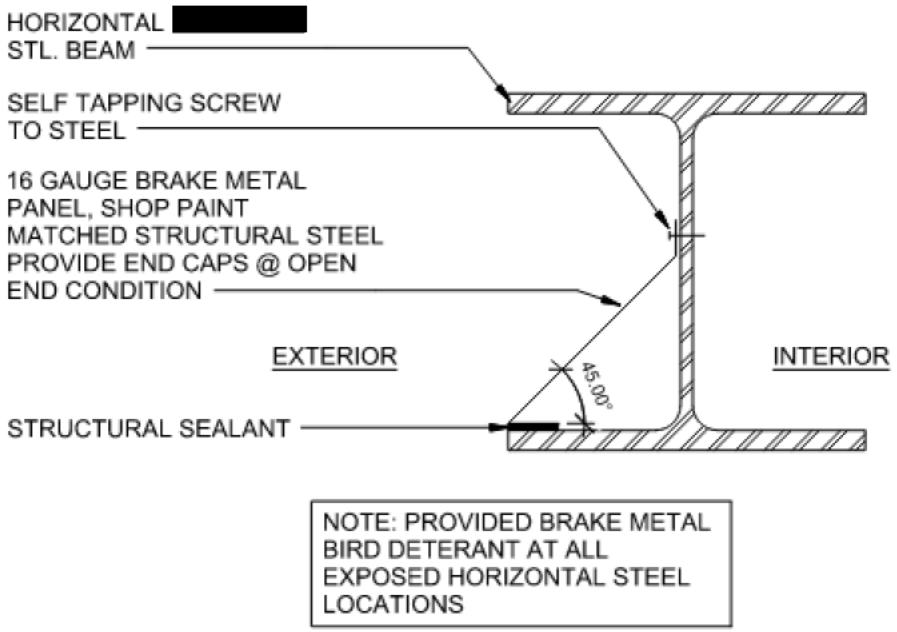
A. The work of this Section will not be measured.

4.02 **PAYMENT**

A. Payment for the work of this Section will be included in the lump sum price bid for the item BIRD CONTROL MATERIAL, which price shall include all work as shown on the Contract Drawings; and shall be full compensation for all labor, materials, tools and equipment, and all else necessary therefor and incidental thereto.

PART 5 - **Detail**

5.01 See below for typical detail.



TYPICAL BIRD DETERANT DETAIL

END OF SECTION

SECTION 14 24 00 - HYDRAULIC ELEVATOR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 GENERAL DESCRIPTION

A. This provides design guidelines for the fabrication, installation, and testing of one (1) in-ground hydraulic elevator at the Metro North Railroad at Purdy's Station.

1.3 ELEVATOR DEFINITIONS

A. Heavy duty elevator: An elevator designed specifically for the harsh environment and duty load cycles common to transportation system usage.

B. Elevator: a hoisting and lowering mechanism, equipped with a car or platform, which moves in guide rails and serves two landings.

C. Elevator, passenger: an elevator used primarily to carry persons other than the operator and persons necessary for loading and unloading.

D. Elevator, hydraulic: a power elevator where energy is applied by means of liquid under pressure in a hydraulic jack or jacks

E. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions

F. Installer: The responsible party who installs the elevator.

G. OEM: Original Equipment Manufacturer.

H. Owner: Metro North Railroad.

I. Substantial completion: The point at which the elevator is ready for use, whether the site is finished or not. This is where the jurisdictional inspection usually takes place.

J. Final Acceptance: The point at which the owner accepts the elevator project as being complete including all submittal requirements. This may be a different point in time than substantial completion.

K. Interim Maintenance: Planned monthly maintenance during the warranty period.

L. Beneficial Use: When the elevator is placed into service, may be prior to the site being ready for public use.

M. Revenue Service: The station or facility opening date.

N. Notice to Proceed (NTP): within this document shall mean the date which the elevator installer is notified to proceed with the project.

O. Authority Having Jurisdiction (AHJ): as defined by ASME A17.1.

P. MSDS: Material Data Safety Sheets, as defined by OSHA

Q. OSHA: Occupational Safety and Health Administration

R. Definitions in ASME A17.1 - 2013

1.4 APPLICABLE CODES, STANDARDS, ORGANIZATIONS AND PUBLICATIONS

A. Elevator designs and installations shall be of the heavy duty type, and shall comply with the following.

1. American Society of Mechanical Engineers (ASME), ASME Al7.1 2013
2. National Fire Protection Association (NFPA)
   a. NFPA No. 130, “Fixed Guideway Transit and Passenger Rail Systems”
   b. NFPA No. 13 and 72
3. National Electrical Code (NEC)
4. American Welding Society (AWS)
5. American Society of Testing and Material (ASTM)
6. International Standards Organization, ISO 281/I-1997
7. American Federation of Bearing Manufacturers Association, AFBMA, Std. 9 and 11
8. National Electrical Manufacturers Association (NEMA)
9. The American Insurance Association
10. Occupational Safety & Health Act (OSHA)
11. International Code Council/ American National Standards Institute, (ICC/ANSI), A117.1-2004
12. American Disabilities Accessibility Guidelines for Buildings and Facilities (ADAAG), 2010
13. Building Officials & Code Administrators International, Inc. (BOCA)
    a. Any additional requirements imposed by local agencies shall be incorporated into elevator installations.
    b. In case of a conflict between codes, regulations, or standards, the most stringent requirement shall take precedence.

1.5 SUBMITTALS

A. Submit OEM’s product data and samples for the system proposed for use.

1. Product Data
   a. Include capacity, size, performance, operation safety features, finishes and similar information.

b. Include product data for car enclosures, hoistway entrances, and operation, control and signal systems.

2. Shop Drawings
   a. Include plans, elevations, sections, and large-scale details indicating service at each landing; machine room layout; coordination with building structure; relationships with other construction; and locations of equipment.
   b. Include large-scale layout of all fixtures.
   c. Indicate maximum dynamic and static loads imposed on building structure at points of support as well as maximum and average power demands.

B. Samples for Initial Selection: Samples of all exposed finish materials, including car and hoistway doors, car flooring, walls, ceiling and glazing.

C. Samples for Verification: For exposed car, hoistway door and signal equipment finishes, 3-inch-square samples of sheet materials and lengths of running trim members.

D. Information Submittal
   1. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on drawings, and electrical service, as shown and specified, are adequate for the elevator system being provided.

   2. As-Built Drawings for the elevator installation, including:
      a. Detailed drawings, control diagrams and schematic electrical wiring diagrams of controller, including safety devices, remote indicating devices, control panel, fault indicating device, and annunciator panel.
      b. Electrical layouts, showing placement of lighting fixtures, switches, receptacles and disconnect switches in machine rooms and pits.
      Four (4) sets of 11" x 17" laminated copy of schematic wiring diagrams for controller and associated devices.

1.6 OPERATING AND MAINTENANCE MANUALS

A. Maintenance Manuals: Prior to installation, Elevator Contractor shall submit two (2) complete sets of operation and maintenance manuals for approval. After Metro North Railroad approval and prior to the beginning of acceptance testing, four (4) sets of the approved manuals shall be provided by the Elevator Contractor.

1.7 ACCEPTANCE AND WARRANTY

A. The piston packing seal should be changed at the following intervals:
   1. Prior to putting the cab into service under beneficial use;
   2. After the 13 month warranty period described in Paragraph 1.7.B, above.

B. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard two-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.8 GUARANTEES

A. Notwithstanding the Specifications forming a part of this Contract, any inspection or approval of the Work by the Engineer, or the existence of any patent or trade name, the Elevator Contractor nevertheless unconditionally guarantees that the equipment furnished and installed hereunder shall be of the best quality and shall be fully fit for the purpose for which it is intended.

1.9 DESIGN CRITERIA

A. General
1. Elevator shall be designed with provisions for thermal expansion and contraction of complete elevator assemblies.

B. Operational Requirements
1. Hours of operation shall be considered as twenty-four (24) hours per day, seven (7) days per week.
2. Specified speed shall be maintained during operating regardless of direction or loading.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Qualifications
1. The work of this Section shall be performed by a firm that is regularly engaged in the business of manufacturing, installing and servicing conveying systems of the type and character required by these specifications. Contractor shall manufacture all major parts of the equipment and shall so state in the request for acceptance listing the items Contractor manufactures.
2. Prior written acceptance is required for manufacturers other than the ones listed, before quoting this project. Requests for acceptance will not be considered unless they are submitted before bid date and are accompanied by the following information:
   a. List of five (5) similar installations having exact equipment being proposed for this project arranged to show name of project, system description and date of completed installation.
   b. Complete literature, performance and technical data describing the proposed equipment.
   c. List of ten service accounts by building name, building manager or Metro-North, including phone numbers.
   d. Location of closest service office from which conveying system will be maintained.
   e. Location of closest parts inventory for this installation.

B. Subject to compliance with the requirements of this Section, provide hydraulic elevators of one of the following manufacturers:
1. Minnesota Elevator, Corp.
2. Canton Elevator Inc.
3. Elevator Equipment Corp. (EECO)
4. Approved equal.

2.2 MATERIAL

A. Except where product conformance to specific standards is indicated on the Contract Drawings and in ASME/ANSI A17.1, OEM's standard materials and equipment may be used in elevator construction, subject to approval. Materials cited below are intended to establish the standard of quality for comparable materials used by the manufacturer.

B. Structural Shapes, Plates, Sheets, and Tubing: ASTM A36 Steel.

C. Sheet Steel: ANSI/ASTM A446, Grade B.

D. Stainless Steel: ASTM A167, Type 304

E. Aluminum: ASTM B211 or ASTM B221, Alloy 6061, T6.

F. Flooring: Provide finish flooring as specified herein.

G. Glass: ANSI Z97.1

2.3 SPECIAL FEATURES

A. General:

1. Elevator shall be of size, arrangement, capacity and shall comply with design criteria specified in this Section and as shown on the Contract Drawings, and in accordance with the requirements of the ANSI/ASME A17.1.
2. Provide all material and equipment necessary for the complete execution of all elevator work as specified in this Section and as shown on the Contract Drawings.
3. Provide hoistway guards for protecting hoistway during construction. Hoistway protection shall include high solid panels surrounding each hoistway opening at each floor.
4. All electric equipment, conduit, fittings and wiring shall conform to the requirements of ANSI/NFPA No. 70 National Electric Code.
5. Provide concrete inserts and other similar anchoring devices for the installation of guide rails, machinery and other elevator components.
6. Clearance around equipment located in each elevator control room and machine area shall comply with the applicable provisions of ANSI/NFPA No. 70 National Electrical Code.
7. Each elevator system is to be provided with a hands free wireless maintenance communication system that provides for communication from within each elevator car enclosure, car top and control room.

2.4 SUMMARY OF FEATURES:

A. Elevator Quantity: One (1)

1.	Elevator Use:	Passenger
2.	Contract Load, in pounds:	4000
3.	Contract Speed, in FPM	125 (with full load)
4.	Travel Distance:	32'-0" (Contractor must V.I.F. prior to fabrication)
5.	Car Size:	per contract drawings

6.	Number of Stops:	2
7.	Number of Openings:	2
8.	Operation:	Simplex Selective Collective
9.	Machine Location:	Adjacent First Floor
10.	Controller Location:	Adjacent First Floor
11.	Machine Type:	Hydraulic Pump Unit
12.	Motor Horse Power:	40 H.P.
13.	Power Supply:	208/480 V, 60Hz , 3 Phase (V.I.F.)
14.	Lighting/ Signal Power Supply:	120V, 60Hz, 20A
15.	Ancillary/Auxiliary Power Supply:	120V, 60Hz, Amperage
16.	Car/Hoistway Door Size:	per contract drawings
17.	Car/Hoistway Door Type:	per contract drawings
18.	Car/Hoistway Door Operation:	Power High-speed, heavy duty
19.	Maximum opening speed:	3.0 FPS
20.	Hoistway Entrance:	As specified.
21.	Cab Enclosure:	As specified.
22.	Cab Flooring:	Poured Acrylic Epoxy or Polymer
23.	Door-Reversal Device:	Non-Contact (Weather Resistant) door reversal device
24.	Signal Equipment:	Type 304 stainless Steel #4 finish with vandal resistant features
25.	Communication System:	Two-way “Hands-Free”
26.	Maintenance Term:	One (1) year

2.5 DOOR OPERATOR EQUIPMENT

A. Provide a water-resistant heavy-duty door operator with encoder-less VVVF drive. Closed loop door operator designed to operate car and hoistway doors simultaneously at the speed specified. Door operator shall be model MOVFR purchased from GAL or approved equal.

1. Provide a three-phase induction motor with a VVVF drive system using a pulse width modulation. A digital closed-loop system shall monitor and control door speed and performance profile.
2. The door shall operate smoothly without a slam during both opening and closing cycles. Door velocity shall be adjustable and continuously monitored to maintain minimum floor-to-floor performances and door operation times.
3. Use a spirator or a weighted door closer to automatically close the hoistway door if the car, for any reason, leaves the landing zone.
4. The car and the hoistway doors shall open as the car stops at the landing and close before the car can leave the floor.
5. Door Contact - Equip the car door with an electric contact, which will prevent operation of the car, unless the car door is in the closed position. The door contacts shall not be readily accessible from the inside of the car.
6. Nudging - If the doors are held open for a predetermined time (15 to 20 seconds; individually adjustable) by interrupting the light rays/detector field, or by holding the door, or by pressing the door open button, a buzzer will sound, and the doors shall start to close at a gentle slow speed.
7. Repeated attempts by the power car door operator mechanisms to open or close the car door at any landing shall be monitored by the new microprocessor control system. In the event the door should fail to cycle properly after a preset (adjustable) number of attempts,

the car shall either travel to the next stop or remove itself from service, depending upon whether the malfunction is in the open or close cycle.

8. Provide a door hold open features for the service elevator that shall be activated by a push button in the car station. Activation of the push button shall reset the door hold open timer by an adjustable time delay (between 10 and 60 seconds).
9. Door Reopening Device – "3D"
   a. Provide a combination infrared curtain and 3D door protection system.
   b. The door shall be prevented from closing from an open position if a person interrupts any one of the curtain light rays or enters the 3D detection zone. When the door is closing, any interruption of either protective light field shall cause both the car and corridor door to reverse. The door shall start to close when the protection system is free of any obstruction.
   c. The infrared curtain and 3D zone protective system shall have:
   d. Height of protective curtain field not less than 71" above the sill.
   e. Height of 3D protective zone field not less than 61" above the sill.
   f. Where a horizontal infrared light beam system is used, provide a minimum of 40 light beams and accurately positioned infrared lights to conform to the requirements of the applicable handicapped code.
   g. Modular design to permit on board test operation and replacement of all circuit boards without removing the complete unit.
   h. Self-contained, selectable 3D zone timeout feature to allow for closing at nudging speed with audible signal.
   i. Automatic turning-off of the 3D zone in the event of three (3) consecutive 3D triggers. Light curtain shall continue to operate after 3D system timeout.
   j. Selectable control of the 3D zone operation on an "always-on" or "as doors close" basis.
   k. Controls to shut down the elevator when the unit fails to operate properly.
   l. Door Hold button to allow lockout for 90 seconds/locking out hall calls

2.6 FIXED HOISTWAY EQUIPMENT

A. Guide Rails:
   1. Guides shall be steel T-section rails. Rail surfaces shall be machined smooth to insure proper operation of guides. Use not less than 15.0 pound per foot car rails.
   2. The section modulus and moment of inertia of the fishplates shall not be less than that of the guide rail. Connect rails to fishplates with eight (8) bolts.
   3. For concrete and concrete block hoistways furnish rail brackets and provide inserts and an insert location drawing to the Construction Manager or General Contractor.
   4. Brackets shall be used to support the rails from the hoistway framing and/or inserts. The rails shall be attached to the bracket by heavy clamps or clips. Bolting or welding rails to brackets shall only be allowed in certain instances. Do not attach brackets to the top flange of hoistway framing steel.
   5. All guide rails shall be erected plumb and parallel to a maximum deviation of 1/8 inch (plus or minus 1/16 inch.)
   6. Provide rail backing and connect rails to the top and bottom of structural members as shown on the structural drawings where the vertical distance between support framing is greater than 14'-0", and no intermediate

B. Car Buffers:
   1. Minimum two (2) spring type with blocking and support.

2. The buffers shall comply in all respects with the requirements of the ASME A.17.1 Code. 3. Provide permanent buffer marking plate which indicates the manufacturer's name, identification number, rated impact speed and stroke.
4. Buffers shall be designed for minimum gross weight of 8000lb load per buffer.

C. Roller Guides: Roller guides shall be mounted on top and bottom of the car frame to engage the guide rails. Provide ELSCO Model B with neoprene roller wheels.

D. Normal Terminal Stopping and Devices:
1. Provide upper and lower normal terminal stopping devices to slow down and stop the car automatically from any speed obtained under normal operation, at or near the top and bottom terminal landings independent of the normal stopping means. The activation of these devices shall cause the elevator, with any load up to and including rated load, to automatically come to a smooth stop.
2. The normal terminal stopping switches shall have rollers with rubber or other approved composition tread to provide silent operation when actuated by the fixed cams in the hoistway. Locate the terminal cams so that they will activate the stopping switches when the elevator travels a predetermined distance above or below the corresponding terminal landings. The switch roller shall engage the full surface area of the cam.

E. Door Interlocks and Emergency Exit Contacts:
1. Equip each elevator hoistway door with a positive interlock which shall prevent the operation of the elevator unless all elevator doors are closed and maintained closed when elevator is away from the landing. The interlocks shall prevent the opening of a hoistway door from the landing side unless the car is within the landing zone and is either stopped or being stopped at that level. Retiring cams used to actuate interlock shall be securely fastened to car construction and be designed to operate without objectionable noise, shock or jar. Design and locate interlocks so that they are not easily accessible from the landing side.
2. Electric contacts shall be provided on all emergency exits to prevent the operation of the elevator when the exit doors or panels are open.

F. Hoistway and Car Door Hangers, Sheaves and Tracks:
1. Provide a sheave type two-point suspension hanger and track for each hoistway and car door. Sheaves shall be hardened steel, not less than 3-1/4 inches in diameter with sealed, grease packed, precision ball bearings.
2. The upthrust shall be taken by a roller mounted on the hanger and arranged to ride on the underside of the track.
3. The track shall be of formed cold rolled steel or cold drawn steel and be rounded on the track surface to receive the hanger sheaves. The track shall be removable and not be integral with the header.
4. The hanger track shall be adjustable. The track shall be capable of being moved up from its final position.

G. Hoistway Entrances:
1. Hoistway entrances shall be the size and type as indicated on the Contract Drawings.
2. Frames: Frames shall be constructed of 14-gauge stainless steel with a #4 satin finish. Frames shall be welded type. At outdoor landings, the frames shall be furnished with weather stripping.
3. Hoistway Doors:

a. The doors shall be full glass doors with a stainless steel frame as shown on the Contract Drawing. The frame shall be constructed of Type 304, 14-gauge stainless steel, with a #4 satin finish. The door panels shall be 1-1/4" thick, reinforced to accept hangers, interlocks or door closers. A hoist door-unlocking device shall be installed on all hoistway doors for emergency purposes. The glass panel of the door shall conform to Division 8.

b. Provide door panel with three (3) removable laminated plastic composition guides, arranged to run in sill grooves with a minimum clearance. The guide mounting shall permit their replacement without removing the door from the hangers. A steel fire stop shall be encased in each guide.

c. Door panels shall be provided with replaceable astragals.

d. Provide stainless steel retainers on hoistway doors in accordance with New York State Building Code.

e. The bottom of the door shall have stainless back up plate.

4. Sills: Provide solid nickel sills with the nosing approximately one (1) inch deep and running the full length of door travel. The sills shall be at least 3/8 inch thick. The wearing surface shall be of a non-slip type with the door guide grooves providing a minimum clearance for the guides. Provide all sill support angles and coordinate their mounting with the other trades. Rigidly bolt sills to the support. Underside supports for sills must extend throughout the full width of the sill area.

5. Entrance sill and its support angles shall be through slotted. A stainless-steel reflector shall be provided and installed under the sills. The reflector shall act as a drain gutter to collect any drained fluid through the sill slots. The reflectors shall be enclosed on one side and pitched towards the open side which shall be the same side as the sump pit of the elevator.

6. Struts: Struts shall be hot rolled steel angles not less than 3 inches by 3 inches by 1/4 inch. Extend the struts from top of sill to either the bottom of floor beam or intermediate framing above. Bolt struts in place with not less than two (2) bolts at each end. Strut clip angles or brackets shall have a thickness not less than the thickness of the supported strut.

7. Track Support: 3/16 inch thick steel track support plate shall extend between and be bolted to the vertical steel struts with no less than two (2) bolts at each end.

8. Track Covers: 14 gauge galvanized steel coverplates shall extend the full travel of the doors. Covers shall be made in sections for service access to hangers, sheaves, tracks and interlocks. The sections above the door opening shall be movable from within the elevator car. Cover fastening devices shall be non-removable from the cover.

9. Fascia: Provide fascia plates on the loading side of elevators, only when the distance between the car sill and hoistway wall is more than 5 inches. When provided, fascia shall be 14-gauge stainless steel and extend at least the full width of the door and be secured as necessary with machine screws. Fascia shall be perforated to provide visibility when they are installed in front of glass walls or a hoistway door.

10. Toe Guards: Provide 14-gauge galvanized steel toe guards to extend a minimum 12 inches below any sill not protected by fascia. The toe guards shall extend the full width of the door and return to the hoistway wall at a 15-degree angle and be firmly fastened.

11. Dust Covers: Provide 14-gauge galvanized steel dust covers to extend 6 inches above any header not protected by fascia. The dust covers shall extend to a full width of travel of the doors, return to the hoistway wall at a 15-degree angle and be firmly fastened.

12. The bottom of each horizontally sliding hoistway door panel shall be equipped with guiding members and safety retainers in accordance with code requirement.

a. The bottom hoistway door panel safety retainers shall be of stainless steel "T" bar or "Z" bar design or shall be otherwise designed to prevent displacement of the door panel.

13. Finishes: All exposed surfaces excluding galvanized steel, stainless steel and sills shall be painted as specified in Division 09. Protect finished surfaces at all times during delivery, storage and installation. Repair finishes which become marred, scratched, abraded, chipped or otherwise not acceptable to the Engineer.
14. Tactile Jamb Plates: Provide tactile jamb plates on each side of each hoistway entrance. Plates shall have 2-inch high white uppercase, sans serif or simple serif type characters on a black background, be raised 1/32-inch from the surface, be accompanied by grade 2 Braille, and be centered at 60 inches above the landing sill. The plates shall have designations matching the Car Operating Panel and Car Position Indicator designations, but may be abbreviated. Plates shall be mounted using Dow Corning No. 999 black adhesive, or approved equal. Mounting studs are not permitted.

H. Stop Switches
1. Provide readily accessible switches to stop and keep the elevator out of service in the pit, on the top of car station, and on the in-car operating panel.
2. Emergency/Stop switches shall be of the pull-out type to prevent accidental activation.

I. Scavenger Pump
1. Provide a positive displacement, rotary type pump for the hydraulic elevator. The pump shall have a discharge pressure of 200-psi maximum and capacity of 10-gallons per hour.
2. The pump shall be self-priming and self-lubricating. The pump shall be equipped with a 100-mesh screen strainer.
3. The pump housing shall be constructed of brass with stainless steel internal parts.
4. Mount oil return pump off the pit floor and connect it to the jack unit and the oil tank with copper tubing.

J. Sump Pump:
1. Pump shall be as specified in specification Division 22.
2. Sump Cover: Hot dip galvanized or stainless-steel grating, minimum ¼" thick.

K. Pit Float Switch:
1. Provide a pit float switch NEMA 4X.

2.7 MACHINE COMPONENTS

A. Power Unit:
1. Provide a self-contained, submersible power unit. It shall include: a structural steel outer base, including tank supports; an oil tight drip pan; an electrically isolated floating inner base for mounting the motor pump assembly underneath the storage tank and sound isolation devices to reduce airborne noises.
2. Provide a reinforced oil reservoir with a tight fitting tank cover over the oil pump unit. Included in the reservoir shall be an oil fill strainer with air filter and a self-cleaning strainer in the suction line. The tank shall have a removable thermostatically controlled 500W screwed on heater. The tank shall have a reserve capacity of not less than 10 gallons. Provide a sight glass with markings for minimum and maximum oil level when the elevator is at the bottom landing.
3. The pump shall be specifically designed for oil hydraulic elevator service and be driven by a single motor, having a maximum speed of 1800 RPM. The motor shall drive the pump with a single, multiple groove, V-belt with sheaves. The motor shall be designed for 120 starts per hour, a 50°C temperature rise and shall have Class F insulation.

4. The motor shall be designed specifically for hydraulic elevator operation.
5. The oil control unit shall be of the manufacturer's own design but shall include relief, safety check, start and slow down valves.
   a. Use lowering and leveling valves for drop away speed, lowering speed, leveling speed and stopping speed to insure smooth down starts and stops.
   b. Provide a valve for manual lowering of the elevator car in event of power failure and for use in servicing and adjusting the elevator mechanism.
   c. Design the tank shut-off valve for isolating oil in the power unit tank to ensure each of servicing and adjusting the elevator mechanism without removing oil from the tank.
   d. All valves shall be accessible for adjustment. All adjustment shall be made without removing the assembly from the oil line.
   e. Valves shall be model UV-5AT purchased from EECO or approved equal.
6. Provide pump unit isolation as manufactured by Mason Industries or approved equal. In addition, contractor shall provide new pump unit tie-down to the machine room floor to prevent displacement.

7. All hardware used to be made of stainless steel

B. Jack Unit:
1. Design and construct the jack in accordance with the applicable requirements of the ASME A.17.1 Code. No brittle material, such as gray cast iron, shall be used in the jack construction.
2. Cylinders: Seamless steel pipe with dual seal. One (1) hydraulic cylinder designed to be in-ground and mounted in the bottom of the car. Design head to receive unit-type packing and provide means to collect oil at cylinder head and return automatically to oil reservoir. The cylinder shall be finished with rust-inhibiting air-dry enamel. Apply two coats by brush, or spray according to manufacturer's recommendations.
3. The cylinder shall have a machined steel flange at the upper end and a heavy steel bulkhead at the lower end.
4. A packing gland with guide bearing, wiper ring and packing especially designed for the hydraulic elevator service shall be mounted at the top of the cylinder along with an oil collector ring and drain hole. The plunger seals shall be urethane cup design with integral wipers or approved equal. Replace the packing glands after all construction is completed.
5. Provide a thermostatically controlled insulated heat tracing assembly on each cylinder to maintain the operating temperature of the oil within acceptable manufacturer's operating range. Provide product details, ambient operating temperature guidelines and design drawings for review and approval.
6. Plungers: Polished seamless steel tubing or pipe. The plunger surface shall be a minimum of 20 micro-inches RMS and shall not exceed 35 micro-inches RMS for the entire plunger length in engagement with the cylinder seals. Provide a stop-ring, electrically welded to the plunger, to positively prevent the plunger from leaving the cylinder.
7. Steel Liner: Schedule 80; inside diameter 2" larger (min.) than the O.D. of the cylinder casing; installed to protect the cylinder/piston unit from exposure to groundwater and electrolytic action.
8. Cylinder Support Frame: Galvanized structural steel channel frame, anchored directly to the pit floor, including baseplate for mounting buffer assemblies.

C. Piping
1. Provide all necessary pipes and fittings to connect the power unit to the jack. Use minimum Schedule 80 steel pipe. Provide a shut off valve in the machine room for maintenance service.

2. Adequately support the full run of pipe with isolation type support.

D. Overspeed Valve (PRV)

1. A safety valve shall be provided to retard the downward motion of the elevator to bring it to a gradual stop in case of a mainline separation or other noncylinder related overspeed condition.
2. The valve shall have a fully adjustable flow rate and be set to actuate at a flow rate which is 125% of the flow rate required to produce the operating speed in the down direction. The valve shall also have an adjustable closing rate and allow manual lowering around the valve when set.
3. The safety valve shall be mounted directly to the jack with threaded connection.
4. The valve shall be provided with a switch to monitor valve position. The switch shall be monitored by the controller.

E. Muffler

1. Provide a new muffler installed in the discharge oil line near the pumping unit. Design shall dampen and absorb pulsation and noise in the flow of hydraulic fluid.

F. Isolation Coupling

1. Provide a new isolation coupling installed in the oil line in the elevator machine rooms.

G. Shut-off Valve

1. Provide new shut off valve in the machine room and pit.

H. Mainline Strainer

1. Provide a mainline strainer of the self-cleaning, compact type, equipped with a 40-mesh element and installed in the oil line.

I. Auto Lowering

1. Provide automatic battery powered lowering feature for the elevator. In the case of normal power outage, an emergency operation shall be activated, lowering the car to the lowest landing. The doors shall be openable manually.
2. The control panel shall be located in the machine room. Include two (2) gel batteries, solid-state controls, charger, monitor lights and a test button and shall be fed by a 120-volt, 20 Ampere branch or circuit.
   a. When normal power is restored, the elevator shall return to normal service only after the completion of the automatic lowering operation.
   b. Provide a test button in the control panel to simulate this operation.

J. Oil Cooling System

1. Provide an oil cooler for the elevator. The oil cooler shall be capable of removing 17,500 BTUH. The unit shall be provided with a 10-micron filter in the oil line.
2. The oil cooler shall be as manufactured by Minnesota Elevator, Inc., or approved equal.
3. The oil cooler shall be turned on and off by the controller, which monitors the temperature of the oil in the tank.

2.8 CONTROLLER COMPONENTS

A. The elevator shall have "non-proprietary" microprocessor-based controller/dispatchers. The controller shall be designed to control the acceleration, deceleration and stopping of the elevator

and to prevent damage to the motor from overload or over current condition. Arrange controls to prevent the operation of the elevator in case of phase reversal, phase failure or low voltage in the power supply. Provide controller manufactured by GAL or approved equal.

B. Place controllers in a totally enclosed NEMA 4 enclosure with a self-supporting steel frame. Provide hinged doors to facilitate service. Within each enclosure provide a locally controlled fluorescent light and a duplex GFCI receptacle.

C. Provide natural or mechanical ventilation for the controller cabinets. Equip ventilate openings and exhaust fans with filters.

D. Mount equipment to moisture-resistant, noncombustible panels. Support these panels from steel frame.

E. Provide "noise filter" between hoistway wiring and controller/dispatchers to eliminate interference.

F. Optically isolate communication cables between components.

G. Controller shall be provided with the capability of communication and the integration with remote monitoring and control system. Contractor shall provide all required ports and outlets in the controller for the connection with the Lift-Net or approved equal system.

H. Wiring: Wiring on the units, whether factory or field wiring, shall be done in neat order, and all connections shall be made to studs and/or terminals by means of grommets, solderless lugs or similar connections. All wiring shall be copper.

I. Terminal Blocks: Provide terminal blocks with identifying studs on units for connection of board wiring and external wiring.

J. Marking: Identifying symbols or letters shall be permanently marked on or adjacent to each device on the unit, and the marking shall be identical with marking used on the wiring diagrams. In addition to the identifying marks, the ampere rating shall be marked adjacent to all fuse holders.

K. Provide a solid-state starter for the pump motor.

L. Diagnostics: For diagnostic work, provide the elevator control system with its own built-in LED or LCD display unit or furnish a service tool. When a fault is detected, the diagnostic system will record the fault code in a nonvolatile memory along with the location of the elevator and the time of day. The display unit shall be used to retrieve this information on every car. The fault information shall include, but not limited to:
   1. Elevator position, travel direction and mode of operation.
   2. Car and hall calls that currently exist within the system
   3. All safety circuits.
   4. Processor power supply and processor and Input/Output status.
   5. Door safety circuits.
   6. Door zone signals.

M. In the event diagnostics and monitoring is accomplished via Field Service Tools, provide the required Field Service Tools with related control system appurtenances for diagnostic evaluations, system monitoring and field adjustments.

1. Provide instructions for proper use of such diagnostic tools and/or equipment with all coding and other operational requirements.
2. Maintain and calibrate the diagnostic tools, and update the associated instructions and other related documents under the service agreement. Should the agreement be cancelled for any reason by either party, maintenance and updating of diagnostic tools shall be provided to Metro-North at the Contractor's cost without the need to purchase or lease additional diagnostic devices, special tools or instructions from the original equipment provider. Metro-North may request field and technical instructions be provided by the original installation contractor or manufacturer for proper servicing by other qualified elevator company personnel. The established cost plus profit, as previously specified, shall be applicable for the life of the system.
3. If the equipment for fault diagnosis is not completely self-contained within the controllers but requires a separate detachable device, that device shall be furnished to Metro-North as part of this installation. Such device shall be in possession of and become property of Metro-North.

N. Microprocessor Documentation
1. Provide and/or obtain complete information on systems' design, component parts, installation and/or modification procedures, adjusting procedures and associated computer conceptual logic circuitry and field connection.
2. Provide microprocessor upgrading and/or modifications to programs that have been assigned to enhance the operation of the equipment for a period of 10 years after project approval.

O. Selector: A floor selector shall be part of the controller microprocessor. Position determination in the hoistway may be through fixed tape in the hoistway. Design the mechanical features and electrical circuits to permit accurate control and rapid acceleration and retardation without discomfort.

P. Provide an automatic stopping device and self-leveling system to ensure that the car lines up with each landing served with a tolerance of no more than plus or minus 1/4" for elevator under all conditions of load for both "up" and "down" travel.

1. The automatic self-leveling system shall correct for overtravel or undertravel and drift.

Q. Simple Selective Collective Operation: As defined by ASME A17.1.

R. Protective Device
1. Should a hydraulic elevator stall due to motor starter failure, low oil condition, or the elevator failing to reach the target landing in the up direction, a protective device shall automatically return the elevator to the bottom landing, open the door and shut down the system.
2. Pressure Switch: Where the top of the cylinder head is above the top of the tank, provide a pressure switch between the cylinder and the valve which shall be activated by the loss of pressure at the top of the cylinder, and control the operation of the elevator as required by the Code.

S. Emergency Control for Fire Department Use
1. Provide Phase I and Phase II firefighter operation in accordance with requirements of Code and local authorities.

2.9 CAB ENCLOSURE COMPONENTS

A. Elevator Car:

1. General:
   a. Elevator car and car components shall meet the applicable requirements of the Code. Car control station and position indicator shall be as specified herein.
2. Car Frame and Platform:
   a. The car frame shall be made of galvanized steel members, with a factor of safety as required by the ASME A.17.1 Code.
   b. The frames and platform shall be braced and reinforced so that no strain will be transmitted to the elevator car.
      1) Provide platform with (1) layer sub-flooring of 3/4" thick marine grade plywood with no knots or filler holes. Cover the underside of the car platform with sheet steel.
      2) Provide work lights, with wire guards and local switch, as well as a 110-volt GFCI receptacles at bottom of platform.
   c. Flooring shall be a five-layer methyl methacrylate (MMA) based decorative chip flooring system. System shall be Cryl-A-Quartz Triple Broadcast floor with Q-28 aggregate, manufactured by Dur-A-Flex, Inc., or approved equal. Colors to be selected by Metro-North.
   d. Allow for a 7'-6" clear cab height.
   e. Design the elevator frame and platform for a Class "A" loading.
3. Appurtenances:
   Handrails: Stainless steel No. 4 finish, flat beam type, 2½" x ½", installed at the side walls of the cab with the handrail top height to meet ADA requirement.
4. CCTV:
   a. Provide provision for this option.

B. Fabrication and Installation

1. Provide elevator cars as shown on the Contract Drawings and as specified herein.
2. The manufacturer of the elevator cars shall have at least five years of experience in providing cars of the type required by this Contract.
3. Wall Panels: Unless otherwise noted on the Contract Drawings, all stainless-steel panels shall be Type 304, 14 gauge, with a 5WL pattern and a #4 finish and all glass shall be 9/16" thick laminated safety glass, complying with ANSI Z97.1. The ANSI Z97.1 markings shall be visible on each individual piece of glass. The public side of all glass shall be provided with a sacrificial coating, as indicated on the Contract Drawings.
4. Ceiling: Unless otherwise noted on the Contract Drawings, ceiling panels, which may be stood on from the car top, shall be 12-gauge stainless steel. The underside of all exposed ceiling panels shall be Type 304 stainless steel with a #4 finish.
5. Front Returns and Entrance Columns: Unless otherwise noted on the Contract Drawings, front returns and entrance columns shall be Type 304 14-gauge stainless-steel, with a 5WL pattern and a #4 satin finish.
6. Ventilation: Two speed, 250/350 cfm, centrifugal exhaust fan, mounted securely to top of ceiling and isolated to prevent vibration and noise within car.
7. Cab Doors: Cab doors shall be full glass with a stainless steel frame as shown on the contract drawings. The frame shall be constructed of formed Type 304, 14 gauge rigidized stainless steel, with a 5WL pattern and No. 4 satin finish, hollow metal flush construction. Door panels shall be reinforced for power operation and furnished with sound deadening. Opening sizes shall be as shown on Contract Drawing and doors shall be of at least 1 1/4"

thick construction. Laminated glass vision panels shall be provided in each door panel to match hoistway door. Doors shall be provided with stainless steel sills.

8. Emergency Exit: Provide a top emergency exit which complies with Code requirements.
9. Car Lighting: LED ceiling light fixtures shall be used. The LED lighting system shall be manufactured by Man-D-Tec, UL Listed, Model SoloBeam-6 (4100k), or approved equal. In case of power loss, a minimum of two (2) lighting fixtures shall be "ON" using the integrated power supply and emergency battery backup system, providing minimum illumination and duration requirement as per Code.
10. The metal car enclosure shall have no sharp edges.

2.10 SIGNAL DEVICES AND FIXTURES

A. General: Provide signal fixtures and control devices for each elevator.

B. Car Operating Station:

1. Provide one (1) main station in the front. This station shall include:
   a. A toggle switch designated "Inspection", and Up and Down direction buttons;
   b. A stop switch;
   c. A 110-volt GFCI duplex receptacle;
   d. A work light with wire guard and an "off"-"on" switch;
   e. An indicator light and a warning buzzer that shall signal Phase I – Fire Emergency Recall Operation.

2. When the station is operational all operating devices in the cab shall be inoperative.

C. Hall Stations:

1. As shown on Contract Drawings.
2. Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Hall fixtures shall be surface mounted and integral hall fixtures shall feature round stainless steel, mechanical buttons marked to correspond to the landings.

3. Include firefighter key switch and designations in the hall station at the designated landing.

D. Hall Lanterns:

1. Tamper resistant hall lanterns shall be equipped with illuminated UP and DOWN signal arrows.
2. Provide a visual and audible signal at each entrance to indicate which car shall stop in response to the hall call.

E. Main Car Operating Panel

1. Provide a main car operating panel surface mounted in the inside car as shown on Contract Drawings.
2. The call buttons provided for each floor served shall cause the car to travel to the floor on momentary pressure of the call button.
3. The call buttons shall become individually illuminated as they are pressed. The button lights shall be extinguished as the calls are answered.
4. The panel shall include:
   a. A call button for each floor served.
   b. Door open button/door close button.
   c. "Alarm" button (illuminating jewel).
   d. "Emergency Stop" keyswitch.

e. Door hold open button. Door hold button shall lock out the elevator for 90 seconds or until door closed button is pressed

f. An intercom station complying with ADA requirements.

5. Service cabinet

a. The locked service cabinet, located below the call buttons, shall be flush and contain the key switches required to operate and maintain the elevator, including, but not limited to:

1) Independent and attendant service switches.
2) Light switch.
3) Fan switch.
4) 110V GFCI duplex receptacle.
5) Out-of-service key switch.
6) Emergency light test button and indicator.

6. Fire Service Cabinet with instructions engraved on back of door.

F. Engraved and epoxy filled elevator capacity, elevator number, "No Smoking", and warning and caution messages as required by the Code.

G. Car position indicator without a separate faceplate.

H. The auxiliary car operating panel shall include:

1. Everything contained on the main car operating panel except:
   a. Service Cabinet
   b. Fire service cabinet

I. Car Position Indicator

1. The position of the car in the hoistway shall be indicated by the illumination of the position indicator numeral corresponding to the floor at which the car has stopped or is passing.
   a. The position indicator shall have illuminated direction arrows to indicate the direction of travel.
   b. Shall be integrated into the COP.

J. Fixture Schedule

1. All hall and car fixtures shall be selected from the manufacturer's heavy-duty fixtures.
2. Custom designed operating and signaling fixtures shall be as shown on the drawings or as approved by Metro-North.
3. Main Car Stations:
   a. Stainless steel with satin finish, surface mounted, swing type, one-piece faceplate with heavy duty concealed hinges.
   b. The layout of the panel and all engraving shall be subject to the approval of Metro-North.
4. Car Position Indicators
   a. Provide 2" high liquid crystal or LED indicators with direction arrows, integral with each car operating panel and in each hall lantern at all floors.
5. Car and Hall Call Buttons
   a. Round stainless steel convex tamperproof type with an illuminating LED halo.
6. Hall Call Stations
   a. Provide Manufacturer standard hall call station
7. Hall Lanterns
   a. 2 ½" high by 2 ½" wide circular or arrow lens constructed of solid sandblasted plexiglass arranged horizontally with faceplate as selected by Metro-North. Arrange

lens for ½" projection from faceplate and provide a 1/8" thick metal separator and a light baffle to form up and down indications. The metal separator shall match the faceplate.

K. Fixture Attachment, Finish and Design

1. Refer to drawings for other design requirements. Where no special design is shown the faceplates shall be as follows:
   a. All floors: 1/8" thick stainless steel with satin finish and tamperproof screws
2. Mount all elevator fixtures with tamperproof fasteners. The screw and key switch cylinder finishes shall match faceplate finish.
3. Where key-operated switch and or key operated cylinder locks are furnished in conjunction with any component of the installation, four keys for each individual switch or lock shall be furnished, stamped or permanently tagged to indicate function.
4. All caution signs, code mandated instructions and directives shall be engraved and filled with epoxy.

L. Wiring

1. Provide all wiring and conduit required for the operation of the elevators.
2. Run all wiring in galvanized conduit or in metal wireways.
3. Flexible metal conduit with ground wiring may be used for short runs from main hoistway wireway to interlocks, fixtures, limit switches and between control panels, motors and brakes.
4. Provide new traveling cables that shall be capable of bending 360 degrees with an inside radius of one foot without any permanent set and without cracking of the outer covering. The open loop shall show no tendency to twist upon itself. Abrupt bending or twisting producing distortion of cable shall not be allowed. Outer covering must remain intact between junction boxes or to controller. Suspend traveling cables with nonmetallic fillers by looping cables around supports. Traveling cables shall include telephone cabling. Cables shall be free from any possible contact with hoistway structure, car, or other equipment. Install shields and pads necessary to prevent chafing and to protect the cables. The loop in the traveling cables shall be not less than 2 feet unless otherwise approved. Each traveling cable conductor shall have a distinctive color-coded outer covering for identification.
   a. Traveling Cables: Flame and moisture-resistant outer cover.
   b. Traveling cables from junction box on car to junction box in hoistway or directly to controller shall consist of flexible traveling cables conforming with requirements of NEC (NFPA 70). Junction boxes in hoistway and on car shall be equipped with terminal blocks. All connections too terminal blocks shall be made with either terminal eyelet connections or pressure wire connectors of the clamp type that meet UL 486A requirements for stranded wire. Terminal blocks shall have permanent indelible identifying numbers for each connection.
   c. Provide 10 percent, but not less than 2, spare conductors in each traveling cable. Tag spares such that they can be identified.
   d. Provide two sets of shielded coaxial conductors in the traveling cable in addition to those wires specified for the two-way communication device in the elevator car or supply a separate cable for the two-way communication device. Cable shall extend from junction box in hoistway or controller to two-way communication device in the car.

2.11 COMMUNICATION & SIGNALING SYSTEM

A. General: Communication and signaling equipment in locations unprotected from weather and/or accessible to the general public, including but not limited to equipment and fixtures installed in elevator cars and hoistways, or at platform and street level landings, shall be of tamper-resistant, heavy-duty stainless-steel construction; enclosures and exposed faces shall be watertight and rated NEMA 4X.
1. All fixtures shall be mounted with concealed hinges and J200 cylinders for the COP, phone, and hall stations. No screws shall be used.
2. Key switches shall be chrome-plated.

B. Car Emergency Communication Panel: As delineated in 2.10 of this Section.
1. Communications & Signaling functions in this panel include:
a. "HELP" button
b. Modified “hands-free” intercom, activated by pressing and releasing the “HELP” button, and including an "ACKNOWLEDGEMENT” light

C. Intercom: 2-way multi-path communication capability between the elevator car and authorized rescue personnel shall be provided via an ADA-compliant, phone line powered intercommunication system; Model G3 by Janus Elevator Products, Inc.
1. The system shall include the following stations:
a. A Car Station, located in the Emergency Communication Panel, which includes a loudspeaker and an adjustable microphone to provide hands-free communication.
b. An Elevator Alarm Panel station, located in the Elevator Machine Room, which will establish communication with authorized rescue personnel via a telephone line maintained by the Railroad.
1) The Alarm Panel shall be programmed to call a minimum of 2 Railroad-designated local response numbers, in a specified order.
2) The external communications cables of the Alarm Panel shall be extended to a junction box in the Machine Room, for connection to the Railroad’s existing communications infrastructure by the General Contractor.
3) The Alarm Panel shall include provisions for 2-way voice communication between the Machine Room and the elevator car.
2. A call shall be placed from the elevator car by pressing and releasing the “HELP” button. This action shall cause the Elevator Alarm Panel to call the designated response number(s), and the “ACKNOWLEDGMENT” light to flash.
a. When the call is answered, the flashing “ACKNOWLEDGMENT” light shall go to a steady condition.
b. Calls shall be disconnected only by authorized personnel outside the car, which will extinguish the “ACKNOWLEDGMENT” lamp.

2.12 MISCELLANEOUS MACHINE ROOM EQUPIMENT:

A. Storage Cabinets
1. Provide one lockable storage cabinet with 30-gallon capacity in the elevator machine room, as shown on the Contract Drawings.
2. The cabinet shall be suitable for storage of cans containing flammables, combustibles, and have factory mutual approval and comply with OSHA regulations for such use. The cabinet shall be Justrite model 892200, or approved equal.

B. Garbage Cans

1. Provide one red fire resistant garbage can with minimum 6 gallon capacity in the elevator machine room, as shown on the Contract Drawings. The garbage can shall be Justrite model 09100 or approved equal.

C. Fire Extinguisher

1. Provide one 'ABC'-class fire extinguisher to be mounted in the machine room as shown on Contract Drawings.

D. Light Switch

1. Provide one machine room light switch. Light switch for elevator light shall be located adjacent to the jamb side of the machine room entry door. NEC 620.23(B).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Condition Inspection

1. Prior to beginning installation of equipment, examine hoistway and machine room areas. Verify no irregularities exist which affect execution of work specified. Do not proceed with installation until work in place conforms to project requirements.
2. Verify dimensions of supporting structure at the site by accurate field measurements. The work shall be accurately fabricated and fitted to the structure, Elevator contractor shall confirm by review of the working drawings and field observation that the clearance and the alignments are proper for the installation of this work.
3. Coordinate work with the work of the other trades, and provide items to be placed during the installation at the proper time to avoid delays in the overall work. Use contactor's bench marks where necessary.

B. Product Delivery, Storage, and Handling

1. Deliver material in Contractor's original, unopened protective packaging.
2. Store material in original protective packaging. Prevent soiling, physical damage, or moisture damage.
3. Protect equipment and exposed finishes from damage and stains during transportation, erection, and construction.

C. Installation

1. Install all equipment in accordance with Contractor's instructions, referenced codes, specification, and approved submittals.
2. Install machine room equipment with clearances in accordance with referenced codes, and specification.
   Install all equipment so it may be easily removed for maintenance and repair.
3. Install all equipment for ease of maintenance.
4. Install all equipment to afford maximum accessibility, safety, and continuity of operation. 5. Remove oil, grease, scale, and other foreign matter from the following equipment and apply one coat of field-applied machinery enamel.
   a. All exposed equipment and metal work installed as part of this work which does not have architectural finish.
   b. Machine room equipment, and pit equipment.

6. Neatly touch up damaged factory-painted surfaces with original paint color. Protect machine- finish surfaces against corrosion.

7. Final payment, for retainage of 10%, shall not be made for the installation work prior to the conclusion of the Warranty / Maintenance period.

D. Field Quality Control

1. Tests:
   a. Perform as required by Code and as required by authorities having jurisdiction.
   b. Provide labor, materials, equipment and connections.
   c. Repair or replace defective work as required.
   d. Pay for restoring or replacing damaged work due to tests.
2. Final Inspection: When all work is completed, and tested, notify Department personnel in writing that the elevator is ready for final inspection and acceptance test. A testing and inspection date shall then be arranged.

E. Adjustments, Painting and Cleaning

1. All equipment shall be adjusted prior to final testing and acceptance.
2. Paint all exposed work which is soiled or damaged during installation. Repair to match adjoining work prior to final acceptance. At a minimum all hoistway and machine room components shall be field painted with at least one coat of machine grade enamel. Paint the machine room and pit floors in a standard grey. The intent is to provide a complete final product that is neat, clean and painted.
3. Keep work areas orderly and free from debris during progress of project. Remove packaging materials daily.
4. Remove all loose materials and filings resulting from work.
5. Clean machine room equipment and floor.
6. Clean hoistways, car, car enclosure, entrances, operating and signal fixtures.

F. Final Service and Inspection

1. Perform specified field testing upon completion of installation of the elevator, prior to acceptance by the Railroad. Field testing shall be performed by a QEI-1 qualified individual, and witnessed by the Railroad's representative.
2. 2 weeks prior to the expiration of its Maintenance Period, the elevator shall be fully serviced, lubricated, and adjusted; and all controls and safety devices shall be checked.
3. A complete inspection will be made by the Metro-North Railroad's representative.

G. Warranty

1. Satisfaction of the testing, startup, training, and maintenance requirements of this Section shall not relieve the Contractor of its obligations under the Warranty provisions of the Contract.

END OF SECTION

Addendum 6

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section includes materials and methods common to other Sections of this Division:
   1. Vibration and Seismic Controls for Plumbing, Piping & Equipment
   2. Identification for Plumbing, Piping & Equipment
   3. Sleeves
   4. Mechanical Sleeve Seals
   5. Formed Steel Channel
   6. Flashing
   7. Field Painting
   8. Motors
   9. Mechanical Demolition
   10. Cutting and Patching

1.2 REFERENCES

A. The publications listed below form a part of this section to the extent referenced. The publications are referred to within the text by the basic definition only. Use latest edition of publication.

B. American National Standards Institute (ANSI/ASME):
   1. Codes for Pressure Piping.
   2. A 13.1 Scheme for the Identification of Piping Systems.

C. American Society of Mechanical Engineers (ASME):
   1. Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

D. American Welding Society (AWS):
   1. Soldering Manual, 2nd edition, 1977.
   2. Brazing Manual, 4th edition, 1991.
   3. A 5.8 Specifications for Filler Metals for Brazing.
   4. D 1.1 Structural Welding Code for Steel.

E. National Electric Manufacturer's Association (NEMA) Standards as apply to specified products.
   1. NEMA MG1; Motors and Generators.

F. Steel Structures Painting Council (SSPC):

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections. Submit in sufficient detail to show full compliance with Contract Documents.

B. Product Data:
1. Submit manufacturer's product data for each product and material
2. Indicate manufacturer, trade names, and model numbers, components, arrangement, and accessories being provided.
3. Include applicable literature, catalog material or technical brochures.
4. Include material and equipment specifications, sizes, types, dimensions, weights, rated capacities, and performance tables or performance curves.
5. Include utility requirements for wiring, piping, and service connection data, motor sizes complete with electrical characteristics.

C. Shop Drawings: Submit shop drawings where required under other individual Sections of this Division
1. Include dimensional data for rough in and installation instructions.
2. Indicate typical layout including dimensions and utility connections.
3. Submit Fabrication Drawings for construction and connections to equipment.
4. Submit drawings showing field measured conditions.
5. Shop drawings detailing fabrication and installation for equipment pads, metal and wood supports and anchorage for materials and equipment.
6. Coordination drawings for access panel and door locations.
7. Submit for piping and equipment identification list of wording, symbols, letter size, and color coding for pipe identification and valve chart and schedule, including valve tag number, location and function.

D. Samples:
1. Submit samples where required under other individual Sections of this Division.

1.4 CLOSEOUT SUBMITTALS:

A. Record Documents
1. Record installed locations and position of systems, components, and accessories.
2. Maintain and update documents on a daily basis.
3. Provide electronic files of Record Documents in addition to Printed copies.

B. Operation and Maintenance Manuals: Submit operation and maintenance manuals for each of the following items of equipment or systems.
1. Pumps, Accessories, and Specialties
2. Plumbing Control Systems.

C. Include the following elements in each O & M manual:
1. Erection or installation instructions.
2. Start-up procedures.
3. Recommended and alternative operating procedures.
4. Schedule of preventive maintenance requirements.

5. Schedule of recommended spare parts to be stocked, complete with part number, inventory quantity, and ordering information.
6. Detailed maintenance procedures.
7. Schedule of lubrication requirements.
8. Corrected and approved control and wiring diagrams.
9. Data sheet listing pertinent equipment or system information, as well as the addresses and telephone numbers of the nearest sales and service representatives.

D. Submit Operation and Maintenance Manuals by complete system.

1.5 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with construction requirements of State, County, and such other local political subdivision's specifications as may exceed the requirements of the codes, standards, and approving bodies referenced herein.
1. Perform Work in accordance with New York State Building Code.

B. Maintain one copy of each document on site.

C. All equipment or apparatus of any one system must be the product of one manufacturer or equivalent products of a number of manufacturers which are suitable for use in a unified or assembled system.

D. Comply with requirements of the National Fire Protection Association (NFPA) Standards referenced in the various Specifications Sections, and as directly appropriate to the work and workmanship.

E. Comply with requirements for both the Underwriters' Laboratories, Inc. (UL) Listings, Labels, and Approvals and the National Electrical Manufacturers' Associations (NEMA) Stamps or Seals as applicable to electrical equipment or apparatus forming parts of the Mechanical Equipment.

F. Certificates and Permits: Upon completion of work, and prior to final payment, furnish to the A/E formal certification of final inspections from authorities having jurisdiction and secure required permits, if any, from such authorities. Additionally, prepare detailed diagrams and drawings, which may be required by those authorities having jurisdiction.

G. Source Quality Control: Products used throughout these specifications, and as indicated on the Drawings, are those of companies having established reputations in the manufacture of the particular materials, equipment, or apparatus specified. Such products may be of their own make, or products of others for which they assume full responsibility when used in said assemblies (which are not manufactured completely by them), and with replacement parts available.

1.6 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. Provide: Furnish and install.

G. Piping: Pipe, fittings, hangers and valves.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to the Project site in a clean condition with openings plugged or capped (or otherwise sealed by packaging) both during shipping and during temporary storage.

B. Delivered equipment crating and/or packaging shall clearly identify pick-points or lift- points. In the absence of crating or packaging, pick-points or lift-points must be identified on the equipment.

C. When unloading materials and equipment provide special lifting harness or apparatus as may be required by manufacturers. Handle materials and equipment in accordance with manufacturer's written instructions.

D. The Contractor shall determine the required equipment needed for unloading operations and have such equipment on site to perform unloading work on the date of equipment delivery.

E. Store materials and equipment, both on and off site, in accordance with manufacturer's written instructions.

F. All equipment and materials shall be stored on palates or dunnage and kept out of contact with the floor or ground

1.8 DRAWING INTERPRETATION AND COORDINATION

A. Plumbing Drawings are diagrammatic and indicate the general arrangement of systems and equipment, unless indicated otherwise by dimensions or Detail Drawings.

B. Plans are intended to show size, capacity, approximate location, direction, and general relationship of one work phase to another, but not the exact detail or arrangement.

C. For locations of building elements, refer to dimensioned Architectural and Structural Drawings and perform field measurements to verify exact locations.

D. Equipment outlines shown on Detail Drawings, or dimensions indicated anywhere on the Drawings, are limiting dimensions. Equipment exceeding approximate dimensions indicated by equipment outlines on Detail Drawings and any equipment or arrangements that reduce indicated clearances or exceed specific equipment dimensions may not be used.

E. Electrical Service Devices:
1. Provide starters, fused disconnect switches or combination starter fusible disconnect switches required for motors and equipment of this Division of the Specifications.
2. Correct sizing of starters and disconnect switches is the joint responsibility of the Contractor and the equipment or apparatus manufacturer.
3. Motor starters shall be minimum NEMA Size 1. Electrical enclosures to be NEMA 12 for indoor units and NEMA 4 for outdoor units unless otherwise indicated on the Drawings.
4. Starters shall be complete with two sets of auxiliary contacts; one set normally open; one set normally closed.
5. For motors 25 HP or greater, provide autotransformer type reduced voltage starters.
6. Motor starters and disconnect switches shall be located as indicated on the Drawings.

1.9 MATERIALS, EQUIPMENT AND WORKMANSHIP

A. Install equipment in strict accordance with manufacturer's instructions for type and capacity of each piece of equipment. Obtain these instructions from the manufacturer and such instructions shall be considered a part of these Specifications. Type, capacity and application of equipment shall be suitable and capable of satisfactory operation.

B. All equipment or apparatus of any one system must be the product of one manufacturer or equivalent products of a number of manufacturers which are suitable for use in a unified or assembled system.

1.10 WARRANTY

A. Extended Warranties: See individual Sections for extended Warranties.

B. Submit manufacturer’s warranty and verify that forms are completed in Owner’s name and registered with manufacturer.

C. Date warranties to date of Substantial Completion for Project.

D. Correct defective Work within a one- year period after Date of Substantial Completion.

1.11 MAINTENANCE

A. Maintenance Service: Maintenance service should be provided for all piping, fixtures, and equipment that is installed or provided under this contract.

B. Provide service and maintenance for one year from date of Substantial Completion, except where longer service is indicated in individual sections.

PART 2 - PRODUCTS

2.1 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

A. Plastic Nameplates: Laminated plastic with engraved letters.

B. Plastic Tags: Laminated plastic with engraved letters, minimum 1-1/2 inches diameter.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Plastic Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape, for direct burial service.

2.2 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

2.3 MECHANICAL SLEEVE SEALS

A. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.4 FORMED STEEL CHANNEL

A. Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

PART 3 - EXECUTION

3.1 INSTALLATION - PIPING AND EQUIPMENT IDENTIFICATION

A. Install plastic nameplates with adhesive.

B. Install plastic tags with corrosion resistant metal chain.

3.2 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install chrome plated steel escutcheons at finished surfaces.

END OF SECTION

SECTION 22 05 03 - PIPES, FITTINGS AND VALVES FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Pipe and pipe fittings for the following systems:
   1. Storm water piping, within5 feet of building.
   2. Bedding and cover materials.

B. Related Sections:
   1. Section 220500 – Common Work Results for Plumbing.

1.2 REFERENCES

A. See Piping Schedule attached to this specification section for Testing Agency reference numbers.

B. American Society of Mechanical Engineers:
   1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
   2. ASME B16.3 - Malleable Iron Threaded Fittings.
   3. ASME B16.4 - Gray Iron Threaded Fittings.
   4. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
   5. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   6. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
   7. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
   8. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

C. ASTM International:
   1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
   2. ASTM B32 - Standard Specification for Solder Metal.
   3. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
   4. ASTM B75 - Standard Specification for Seamless Copper Tube.
   5. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
   6. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
   7. ASTM B302 - Standard Specification for Threadless Copper Pipe, Standard Sizes.
   8. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).
   9. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
   10. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
   11. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

12. ASTM C1053 - Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications.
13. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
14. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
15. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
16. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
17. ASTM D2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
18. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
19. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
20. ASTM F437 - Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
21. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
22. ASTM F439 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
23. ASTM F441/F441M - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
24. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
25. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
26. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

D. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

E. American Water Works Association:
1. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
2. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

F. Cast Iron Soil Pipe Institute:
1. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings forStorm Drain Piping Applications.
2. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Storm Drain Piping Applications.

1.3 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes. Submit shop drawings sealed by registered professional engineer.

C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.

D. Design Data: Indicate pipe sizes. Indicate pipe sizing methods. Indicate calculations used. Submit sizing methods and calculations sealed by registered professional engineer.

1.4 CLOSEOUT SUBMITTALS

A. Division 01 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations and sizes of valves.

C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

B. Perform Work in accordance with the Plumbing Code of New York State.

C. Maintain one copy of document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience approved by manufacturer.

C. Design piping systems under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of New York.

1.7 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements: Environmental conditions affecting products on site.

B. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 COORDINATION

A. Division 01 - Administrative Requirements: Requirements for coordination.

B. Coordinate installation of buried piping with trenching.

1.12 WARRANTY

A. Division 01 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish five year manufacturer warranty for valves excluding packing.

1.13 EXTRA MATERIALS

A. Division 01 - Execution and Closeout Requirements: Requirements for extra materials.

B. Furnish two packing kits for each size valve.

PART 2 - PRODUCTS

2.1 PIPE, VALVES AND PIPE FITTINGS

A. Refer to individual pipe material schedules at the end of this section for pipe, valve and fitting materials and joining materials and methods.

2.2 MANUFACTURERS

A. Pipe and Fittings:
   1. Charlotte Pipe and Foundry Co.
   2. Mueller Industries.
   3. Nibco, Inc.
   4. Orion Fittings
   5. Tyler Pipe

B. Valves
   1. Conbraco Industries, Apollo Valve Division.
   2. Milwaukee Valve Company.
   3. NIBCO, Inc.
   4. Stockham Valves & Fittings.

2.3 BEDDING AND COVER MATERIALS

A. Bedding: See Division 31.

B. Cover: See Division 31.

C. Soil Backfill from Above Pipe to Finish Grade: See Division 31.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify excavations are to required grade, dry, and not over-excavated.

C. Verify trenches are ready to receive piping.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection to existing piping system size, location, and invert are as indicated on Drawings.

B. Establish elevations of buried piping with not less than 4 ft. of cover.

C. Establish minimum separation of 5' from sanitary sewer piping in accordance with plumbing code.

D. Excavate pipe trench in accordance with Section 31.

E. Install pipe to elevation as indicated on Drawings.

F. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches compacted depth; compact to 95 percent maximum density. The Contractor is to retain a testing company to test soil & confirm compaction level.

G. Install pipe on prepared bedding.

H. Route pipe in straight line.

I. Install pipe to allow for expansion and contraction without stressing pipe or joints.

J. Install shutoff and drain valves at locations indicated on Drawings in accordance with this Section.

K. Install trace wire continuous buried 6 inches below finish grade, above pipe line; coordinate with Division 31.

L. Pipe Cover and Backfilling:
1. Backfill trench in accordance with Division 31.
2. Maintain optimum moisture content of fill material to attain required compaction density.
3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 6 inches minimum cover over top of jacket. Compact to 95 percent maximum density. The Contractor is to retain a testing company to test the soil & confirm the compaction level.
4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
5. Do not use wheeled or tracked vehicles for tamping.

M. Install Work in accordance with plumbing code of New York State.

3.4 INSTALLATION - ABOVE GROUND PIPING

A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

C. Group piping whenever practical at common elevations.

D. Sleeve pipe passing through partitions, walls and floors. Refer to Section 22 05 00.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 00.

F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 00.

G. Provide access where valves and fittings are not accessible.

H. Install non-conducting dielectric connections wherever jointing dissimilar metals.

I. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum. Maintain gradients.

J. Slope piping and arrange systems to drain at low points.

K. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

L. Install piping penetrating roofed areas to maintain integrity of roof assembly.

M. Install valves in accordance with Section 22 05 00.

N. Install piping specialties in accordance with Section 22 05 00.

O. Insulate piping. Refer to Section 22 05 00.

P. Install pipe identification in accordance with Section 22 05 00.

3.5 INSTALLATION - STORM DRAINAGE PIPING SYSTEMS

A. Install storm drainage piping systems in accordance with the Plumbing Code of New York State.

B. Install storm drainage piping systems in accordance with Section 22 05 00.

C. Install bell and spigot pipe with bell end upstream.

D. Support cast iron drainage piping at every joint.

3.6 FIELD QUALITY CONTROL

A. Division 01 - Quality Requirements - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B.

C. Test storm drainage piping system in accordance with local authority having jurisdiction.

3.7 CLEANING

A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.

END OF SECTION

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
   2. All application specific requirements that appear in Divisions. 22, 23 & 26, which commonly require more demanding requirements, apply to this Section.

B. This Section includes the following materials and methods common to other Sections of this Division:
   1. Sleeves and Seals
   2. Grout
   3. Pipe and Pipe Fittings
   4. Joining Materials
   5. Piping Specialties
   6. Identification for Piping and Equipment
   7. Fire-stopping
   8. Flashing
   9. Painting
   10. Motors
   11. Cutting and Patching

1.2 REFERENCES

A. The publications listed below form a part of this section to the extent referenced. The publications are referred to within the text by the basic definition only. Use latest edition of publication.

B. American National Standards Institute (ANSI):
   1. ANSI/ASME B31; Code for Pressure Piping.
   2. A 13.1 Scheme for the Identification of Piping Systems.
   3. B 31 Code for Pressure Piping.

C. American Society of Mechanical Engineers (ASME):
   1. Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

D. American Welding Society (AWS):
   1. Soldering Manual. 2nd ed. 1977.
   2. Brazing Manual. 4th ed. 1991.
   3. A 5.8 Specifications for Filler Metals for Brazing.
   4. D 1.1 Structural Welding Code for Steel.

E. National Electric Manufacturer's Association (NEMA) Standards as apply to specified products.

Addendum 6

1. NEMA MG1; Motors and Generators.

F. Steel Structures Painting Council (SSPC):

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections. Submit in sufficient detail to show full compliance with Contract Documents.

B. Product Data:
1. Submit manufacturer's product data for each product and material
2. Indicate manufacturer, trade names, and model numbers, components, arrangement, and accessories being provided.
3. Include applicable literature, catalog material or technical brochures.
4. Include material and equipment specifications, sizes, types, dimensions, weights, rated capacities, and performance tables or performance curves.
5. Include utility requirements for wiring, piping, and service connection data, motor sizes complete with electrical characteristics.

C. Shop Drawings: Submit shop drawings where required under other individual Sections of this Division:
1. Include dimensional data for rough in and installation instructions.
2. Indicate typical layout including dimensions and utility connections.
3. Submit Fabrication Drawings for construction and connections to equipment.
4. Submit drawings showing field measured conditions.
5. Shop drawings detailing fabrication and installation for equipment pads, metal and wood supports and anchorage for materials and equipment.
6. Coordination drawings for access panel and door locations.
7. Submit for piping and equipment identification list of wording, symbols, letter size, and color coding for pipe identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
8. Requirements of this section do not relieve the Contractor of requirement to address specific shop drawing requirements for each technical specification section under Division 23.

D. Samples:
1. Submit samples where required under other individual Sections of this Division.

1.4 CLOSEOUT SUBMITTALS:

A. Record Documents
1. Record installed locations and position of systems, components, and accessories.
2. Maintain and update documents on a daily basis.
3. Provide electronic files of Record Documents in addition to Printed copies.

B. Operation and Maintenance Manuals: Submit operation and maintenance manuals for each of the following items of equipment or systems.
1. Heating and Cooling Equipment Heat Pump.

C. Include the following elements in each O & M manual:
   1. Erection or installation instructions.
   2. Start-up procedures.
   3. Recommended and alternative operating procedures.
   4. Schedule of preventive maintenance requirements.
   5. Schedule of recommended spare parts to be stocked, complete with part number, inventory quantity, and ordering information.
   6. Detailed maintenance procedures.
   7. Schedule of lubrication requirements.
   8. Corrected and approved control and wiring diagrams.
   9. Data sheet listing pertinent equipment or system information, as well as the addresses and telephone numbers of the nearest sales and service representatives.

D. Submit Operation and Maintenance Manuals by complete system.

1.5 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Comply with construction requirements of State, County, and such other local political subdivision's specifications as may exceed the requirements of the codes, standards, and approving bodies referenced herein.
   1. Perform Work in accordance with the Uniform Construction Code.
   2. Perform Work in accordance with local Authorities having Jurisdiction

B. Maintain one copy of each document on site.

C. Qualify welding processes and operators for structural steel according to AWS D1.1.

D. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX.
   1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

E. All equipment or apparatus of any one system must be the product of one manufacturer or equivalent products of a number of manufacturers which are suitable for use in a unified or assembled system.

F. Comply with requirements of the National Fire Protection Association (NFPA) Standards referenced in the various Specifications Sections, and as directly appropriate to the work and workmanship.

G. Comply with requirements for both the Underwriters' Laboratories, Inc. (UL) Listings, Labels, and Approvals and the National Electrical Manufacturers' Associations (NEMA) Stamps or Seals as applicable to electrical equipment or apparatus forming parts of the Mechanical Equipment.

H. Certificates and Permits: Upon completion of work, and prior to final payment, furnish to the A/E formal certification of final inspections from authorities having jurisdiction and secure

required permits, if any, from such authorities. Additionally, prepare detailed diagrams and drawings, which may be required by those authorities having jurisdiction.

I. Source Quality Control: Products used throughout these specifications, and as indicated on the Drawings, are those of companies having established reputations in the manufacture of the particular materials, equipment, or apparatus specified. Such products may be of their own make, or products of others for which they assume full responsibility when used in said assemblies (which are not manufactured completely by them), and with replacement parts available.

1.6 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. Provide: Furnish and install.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to the Project site in a clean condition with openings plugged or capped (or otherwise sealed by packaging) both during shipping and during temporary storage.

B. Delivered equipment crating and/or packaging shall clearly identify pick-points or lift- points. In the absence of crating or packaging, pick-points or lift-points must be identified on the equipment.

C. When unloading materials and equipment provide special lifting harness or apparatus as may be required by manufacturers. Handle materials and equipment in accordance with manufacturer's written instructions.

D. The Contractor shall determine the required equipment needed for unloading operations and have such equipment on site to perform unloading work on the date of equipment delivery.

E. Store materials and equipment, both on and off site, in accordance with manufacturer's written instructions.

1.8 DRAWING INTERPRETATION AND COORDINATION

A. Mechanical Drawings are diagrammatic and indicate the general arrangement of systems and equipment, unless indicated otherwise by dimensions or Detail Drawings.

B. Plans are intended to show size, capacity, approximate location, direction, and general relationship of one work phase to another, but not the exact detail or arrangement.

C. For locations of building elements, refer to dimensioned Architectural and Structural Drawings and perform field measurements to verify exact locations.

D. Equipment outlines shown on Detail Drawings, or dimensions indicated anywhere on the Drawings, are limiting dimensions. Equipment exceeding approximate dimensions indicated by equipment outlines on Detail Drawings and any equipment or arrangements that reduce indicated clearances or exceed specific equipment dimensions may not be used.

E. Electrical Service Devices:
   1. Provide starters, fused disconnect switches or combination starter fusible disconnect switches required for motors and equipment of this Division of the Specification, which are not specified elsewhere.
   2. Correct sizing of starters and disconnect switches is the joint responsibility of the Contractor and the equipment or apparatus manufacturer.
   3. Motor starters shall be minimum NEMA Size 1. Electrical enclosures to be NEMA 12 for indoor units and NEMA 4 for outdoor units unless otherwise indicated on the Drawings.
   4. Starters shall be complete with two sets of auxiliary contacts; one set normally open; one set normally closed.
   5. Motor starters and disconnect switches shall be located as indicated on the Drawings.

1.9 MATERIALS, EQUIPMENT AND WORKMANSHIP

A. Install equipment in strict accordance with manufacturer's instructions for type and capacity of each piece of equipment. Obtain these instructions from the manufacturer and such instructions shall be considered a part of these Specifications. Type, capacity and application of equipment shall be suitable and capable of satisfactory operation.

B. All equipment or apparatus of any one system must be the product of one manufacturer or equivalent products of a number of manufacturers which are suitable for use in a unified or assembled system.

1.10 WARRANTY

A. Extended Warranties: See individual Sections for extended Warranties.

B. Submit manufacturer’s warranty and verify that forms are completed in Owner’s name and registered with manufacturer.

C. Date warranties to date of Substantial Completion for Project.

D. Correct defective Work within a one year period after Date of Substantial Completion.

1.11 MAINTENANCE

A. Maintenance Service:

B. Provide service and maintenance for one year from date of Substantial Completion, except where longer service is indicated in individual sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Use of Trade Names: The use of trade names on the drawings or other documents is to establish a basis of design, constructability, and level of quality. It is not intended to exclude other manufacturers whose products are equivalent to those named, subject to compliance with Contract requirements.

B. Alternates and Substitutions: In accordance with the Contract Documents, including General and Supplemental Conditions.

2.2 SLEEVES AND SEALS

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or gage thick galvanized steel.

C. Sleeves for Ductwork: Galvanized steel, gauge to match ductwork.

D. Pipe Sleeve Sizing:
   1. Un-insulated Pipes: Size sleeves two pipe sizes larger than pipe passing through, or size sleeves for a minimum of 1/2-inch clearance between inside of sleeve and outside diameter of pipe passing through.
   2. Wall Seal Sleeve: Size sleeves to accommodate the pipe plus the hydrostatic Wall Seal.
   3. Insulated Pipes: Size sleeves for a minimum of 1/2-inch clearance between inside of sleeve and outside diameter of insulation covering on pipes passing through.
   4. Sleeve Length:
      a. Wall and Partitions: Equal to total thickness of wall or partitions and terminated flush with finished surfaces.
      b. Floors: Equal to total depth of floor construction including finish and extending a minimum of one inch above floor level.

E. Sleeve Materials:
   1. Pipe Sleeves In Cast-In-Place Concrete: Fabricate from Schedule 10 black steel pipe and weld a 2-inch wide intermediate anchoring flange of 3/16-inch steel midway on pipe sleeve; or provide sleeve as furnished by wall seal manufacturer.
   2. Pipe Sleeves in Masonry: No. 18 gauge galvanized sheet steel.
   3. Pipe Sleeves in Wallboard Partitions: No. 18 gauge galvanized sheet steel with anchoring flanges or tabs.

F. Wall Pipe: Cast iron construction with an integral intermediate anchoring flange midway on the pipe exterior.
   1. Wall pipe ends of type indicated on Drawings, and where not indicated, pipe end shall match that of adjoining pipe.
   2. Provide wall pipes similar to those manufactured by Clow Corporation, American Cast Iron Pipe Co., U.S. Pipe and Foundry Co.

G. Seals:
   1. Manufacturers:
      a. Thunderline Link-Seal, Inc.
      b. NMP Corporation.
      c. Substitutions: Permitted and Subject to Approval
   2. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

H. Plates:
   1. Wall and Ceiling Plates: Cast metal with integral set screw or similar anchoring screw. Hinged or split design plates may be provided.
   2. Escutcheons: Provide chrome plated stamped steel hinged plates to close pipe penetrations through structure interior in finished areas. Provide plates designed to lock on pipes using setscrews.

I. Pre-Fabricated Roof Penetration Seal: Provide a factory pre-fabricated system of materials acceptable to or by the existing roofing system membrane manufacturer.
   1. The pre-fabricated system design shall accommodate multiple pipes and conduits in a single fabricated curb and EPDM pipe portal unit.

J. Sealant: Refer to Architectural Drawings for requirements

2.3 GROUT:

A. Non-shrink, Nonmetallic Grout: ASTM C 1107, Grade B.
   1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory-packaged.

2.4 PIPE AND PIPE FITTINGS:

A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.

2.5 JOINING MATERIALS:

A. Refer to individual piping system specification Sections in Division 23 for special joining materials not listed below.

B. Brazing Filler Metals: AWS A5.8.
   1. BCuP Series: Copper-phosphorus alloys.
   2. BAg1: Silver alloy.

C. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.6 PIPING SPECIALTIES:

A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type where required to conceal protruding fittings and sleeves.
   1. Inside Diameter: Closely fit around pipe, tube, and insulation.
   2. Outside Diameter: Completely cover opening.
   3. Cast Brass: Split casting, with concealed hinge and set-screw.
   4. Finish: Polished chrome plate.
   5. Stamped Steel: Split plate, with concealed hinge, set-screw, and chrome-plated finish.

2.7 IDENTIFICATION FOR PIPING AND EQUIPMENT

A. Refer to Section 23 05 53.

B. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on light background color.

C. Plastic Tags: Laminated three-layer plastic with engraved black letters on light background color, minimum 1-1/2 inches diameter.

D. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener. Color and Lettering: Conform to ASME A13.1.

E. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Color and Lettering: Conform to ASME A13.1.

F. Plastic Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 inches thick, manufactured for direct burial service.

2.8 FIRESTOPPING

A. Refer to Architectural Drawings for Fire-stopping requirements.

B. Provide fire-stopping against the spread of fire, smoke and gases where penetrations occur for piping and ductwork.

2.9 FLASHING

A. Flash and counter flash where mechanical equipment passes through exterior or waterproofed walls, floors and roofs.

B. Flash pipes projecting 12 inch minimum above finished roof surface with flashing worked 1 inch minimum into hub, 8 inch minimum clear on sides with minimum 24 x 24 inch sheet size. For pipes through outside walls turn flange back into wall and caulk.

C. Provide curbs for mechanical roof installations 12 inch minimum high. Flash and counter flash with galvanized steel, soldered and made waterproof.

D. Metal Flashing: 26 gage thick galvanized steel.

E. Metal Counter flashing: 22 thick galvanized steel.

F. Lead Flashing:
   1. Waterproofing: 5 lb./sq. ft sheet lead.
   2. Soundproofing: 1 lb./sq. ft sheet lead.

G. Flexible Flashing: 47 thick sheet compatible with roofing.

H. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.10 PAINTING

A. Shop Paint: For primer coats provide only those primers that are compatible with field coats specified on Architectural Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Refer to equipment specifications in other Sections for roughing-in requirements.

3.2 INSTALLATION

A. General Requirements: Install equipment, components, and materials at locations indicated on the Drawings and in accordance with manufacturer’s instructions..

3.3 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS:

A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.

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B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the CM.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.

D. Perform required interconnection of mechanical systems to other mechanical and electrical equipment, devices, or apparatus, regardless of where such Products are specified, in order to ensure the completeness of such mechanical systems.

E. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

F. Install equipment giving right-of-way to piping systems installed at a required slope.

G. All equipment shall operate without objectionable noise or vibration as determined by the Owner. If such objectionable noise or vibration should be produced by apparatus, piping, ducts or other parts of this work, make necessary changes, as determined by the Owner without additional compensation.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General: Install piping as described below, unless piping Sections specify otherwise. Individual piping Sections specify unique piping installation requirements.

B. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

C. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome- plated finish. Use split-casting escutcheons if required, for existing piping.

D. Un-insulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.

E. Un-insulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.

F. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.

G. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

3.5 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with mechanical sleeve seals.

B. Set sleeves in position in forms. Provide reinforcing around sleeves.

C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

D. Extend sleeves through floors 2 inches above finished floor level. Caulk sleeves full depth and provide floor plate.

E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire-stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

F. Install stainless steel escutcheons at finished surfaces.

G. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.

H. Provide foundation sleeves for those piping installations where piping is designed to pass through a foundation wall and does not form an integral part of the wall.

I. Provide the proper gland and gasket to make a watertight seal on piping passing through the foundation sleeve.

3.6 SEALS AND PLATES INSTALLATION

A. Following pipe installation through sleeves in exterior walls below grade, install Wall Seal to render installation leak free. Wall Seal not required in interior walls, partitions, floor and ceilings.

B. Install wall seal as close to outside surface of wall as possible to provide a watertight seal below grade. Apply a coating of coal tar paint or other type-approved coating on bolt heads and other metal parts on below grade wall seals prior to backfilling.

C. Install wall and ceiling plates to close pipe sleeve openings.

D. Install escutcheons to close pipe sleeve openings in finished areas.

3.7 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.

B. Locate holes and provide sleeves, cutting and fitting required for mechanical work. Relocate improperly located holes and sleeves.

C. Repair cut surfaces to match adjacent surfaces.

D. Perform patching in finished construction of building under the sections of specifications covering these materials.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGE:

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

3.9 GROUTING

A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases to provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

3.10 FIRESTOPPING

A. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire-stopping sealant material.

3.11 INSTALLATION - PIPING AND EQUIPMENT IDENTIFICATION

A. Refer to Section 23 05 53 – Identification for HVAC Piping and Equipment.

B. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

C. Install plastic tags with corrosion resistant metal chain.

D. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of mechanical equipment.

E. Install plastic nameplates with adhesive.

F. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows, showing duct system service and direction of flow.

G. Adjusting: Relocate identifying devices as necessary for unobstructed view in finished construction.

3.12 PAINTING AND FINISHING

A. Refer to Architectural drawings for Painting requirements.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.13 FIELD QUALITY CONTROL

A. General: Perform cleaning, testing, startup, adjusting, balancing, and commissioning operations as specified in other Sections included under Division 23 - Mechanical.

3.14 PROTECTION

A. Protect equipment and materials in storage on site, during and after installation until final acceptance. Leave factory covers in place and take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

B. Protect equipment with polyethylene covers and crates.

C. Protect installed work from subsequent construction activities.

D. Operate, drain and flush bearings and refill with change of lubricant before final acceptance.

E. Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Provide extended nipples for lubrication.

F. Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not re-use existing materials and equipment unless specifically indicated.

END OF SECTION

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Requirements for basic electrical studies and reports, material handling, and other basic electrical materials and methods.

B. Related Sections:
1. Section 01 33 00 - Submittal Procedures.
2. ~~Section 09 90 00 - Painting.~~
3. Section 26 05 26 - Grounding and Bonding.
4. Section 26 05 28 - Hangers and Supports for Electrical Systems.
5. Section 26 05 53 - Identification for Electrical Systems.
6. Section 26 05 63 - Acceptance Testing of Electrical Systems.
7. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
8. Section 26 05 33.13 – Conduit for Electrical Systems.
9. Section 26 05 33.16 - Boxes for Electrical Systems
10. ~~Section 26 05 36 - Cable Trays for Electrical Systems~~
11. Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

A. America National Standards Institute (ANSI):
1. ANSI Z535.4, Product Safety Signs and Labels.

B. American Society of Mechanical Engineers (ASME):
1. ANSI/ASME Y14.2M, Line Conventions and Lettering.
2. ANSI/ASME Y14.24M, Types and Applications of Engineering Drawings.
3. ANSI/ASME Y14.34M, Associated Lists.
4. ANSI/ASME Y14.35M, Revision of Engineering Drawings and Associated Documents.
5. ANSI/ASME Y14.100, Engineering Drawing Practices.

C. Institute of Electrical and Electronic Engineers (IEEE):
1. ANSI/IEEE 18, Standard for Shunt Power Capacitors.
2. ANSI/IEEE 141, Recommended Practice for Electric Power Distribution for Industrial Plants - Red Book.
3. ANSI/IEEE 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - IEEE Buff Book.
4. ANSI/IEEE 399, Recommended Practice for Power Systems Analysis - Brown Book.
5. ANSI/IEEE 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
6. IEEE 1036, Guide for Application of Shunt Power Capacitors.
7. ANSI/IEEE 1584, Guide for Arc-Flash Hazard Calculations.

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8. ANSI/IEEE C37.10, Guide for Diagnostics and Failure Investigation of Power Circuit Breakers.
9. ANSI/IEEE C37.13, Low-Voltage AC Power Circuit Breakers Used in Enclosures.
10. ANSI/IEEE C57.12.00, General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers.
11. ANSI/IEEE C57.12.59, Standard for Dry-Type Transformer Through-Fault Current Duration

D. InterNational Electrical Testing Association, Inc. (NETA):
1. ANSI/NETA ETT Standard for Certification of Electrical Testing Technicians.

E. National Electric Manufacturer's Association (NEMA).
1. ANSI/NEMA MG 1, Motors and Generators.
2. NEMA ICS 6, Industrial Control and Systems: Enclosures.

F. National Electrical Design Builders Association (NECA)
1. ANSI/NECA 100 Symbols for Electrical Construction Drawings.

G. National Fire Protection Association (NFPA):
1. NFPA 70, National Electrical Code (NEC).
2. NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces.

H. The Society for Protective Coatings (SSPC):
1. SSPC-SP 2, Hand Tool Cleaning.

I. Other Published References:
1. Electrical Safety Handbook, by John Cadick, McGraw Hill, Inc., Article on Safety Electrical One-Line Diagrams.

1.3 DEFINITIONS

A. PCC: Point-of-Common-Coupling, which occurs at terminals to which both harmonic producing loads, such as variable speed drives, and non-harmonic producing loads are connected.

B. THD: The Total Harmonic Distortion of the electrical system, including the effects of all harmonics.

C. UPS: Uninterrupted power supply, usually an independent electrical power supply designed to provide power when normal electrical service is interrupted.

1.4 DESIGN REQUIREMENTS

A. The contractor shall Prepare and submit a Short Circuit, Arc-Flash, and Protective Device Coordination Study and a Harmonic Distortion Study as specified in this Article.

B. The studies shall be performed under the supervision of a professional engineer using computer software by SKM Systems Analysis Power Tools, ETAP or equal.

1. Immediately after award of the Contract, collect all data needed to perform calculations for the studies.

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a. Obtain, in writing, electrical utility source information and any other information required from the utility to perform the necessary studies directly from the serving utility.
b. The Owner and Engineer will provide, as available, information about the portions of the facility's existing electrical system affected by the work performed under this Contract.
1) The Owner will provide two copies of the latest revision of the existing facility record drawings and the facility equipment list to the Contractor for use in defining existing equipment load requirements.
2) Base the contribution of motors on actual motor loads as indicated on the equipment list, system one-line diagrams, and panel schedules.
3) If the information provided is insufficient to perform the studies or represents unknown ratings of existing equipment, investigate and obtain the information required.
a) Employ qualified technicians to obtain the necessary data.
c. Obtain data for new equipment directly from suppliers and other Contractors working on the project.

2. Once the data needed is obtained, perform a preliminary computerized Short Circuit, Arc-Flash, and Protective Device Coordination Study and a preliminary computerized Harmonic Distortion Study, both complete with calculations.
a. At least two full calendar weeks prior to submitting Shop Drawings for equipment included the respective studies, submit the preliminary studies and corresponding computer printouts and annotated one-line distribution diagram to the Engineer for review and comment.
b. After the Engineer provides his comments, submit four copies of the revised and corrected preliminary studies.

3. Include the following types of information common to each study:
a. Calculations and tabulations.
1) Ensure that the calculations in the Short Circuit, Arc-Flash, and Protective Device Coordination Study are sufficient to ascertain interrupting and/or withstand ratings of the equipment.
a) Identify items of distribution system equipment that are not rated for the available fault current, and provide corrective recommendations for consideration.
2) Ensure the calculations in the Harmonic Distortion Study are sufficient to ascertain the adequacy of harmonic filter performance.
b. Data on the computer programs used to perform calculations and tabulations.
c. An appendix to each report that includes the information obtained from outside entities, agencies, electrical manufacturers, the serving utility company, field inspections, and other field sources such as the following:
1) Copies of letters.
2) Photographic records.
3) Nameplate tracings.
4) Actual data sources from which the data and information was obtained.

C. Final Project Report:
1. After the Engineer accepts the revised and corrected preliminary studies, prepare a report summarizing the results of the individual studies; and submit this Final Project Report to the Engineer for acceptance and approval.
a. Include the following sections in the Final Project Report:
1) Description.

2) Purpose.
3) Basis and scope of the study.
a) A single line diagram of that portion of the power system that is included within the scope of the study.
b) Computerized time versus current coordination graphs and corresponding printouts for protective devices.
c) Include the feeder cable damage curves associated with the items being coordinated in these graphs.
d) Include the ANSI/NEMA MG 1 damage points for the motors in the system and the ANSI/IEEE C57.12.00 mechanical and electrical damage points on the curves.
4) Tabulations of the relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
5) Harmonic data at Points-of-Common-Coupling (PCC).

b. Submit ten bound copies of the Final Project Report for review and approval and two copies of record drawings showing the existing facility as it was before the work of this Contract was performed.

c. Once the Final Project Report has been approved, forward one additional bound final copy of the report to the Owner.

D. Short Circuit, Arc-Flash, and Protective Device Coordination Study:

1. Prepare the Short Circuit, Arc-Flash, and Protective Device Coordination Study under the supervision of a Professional Engineer licensed in the state of NY, or have a NETA certified electrical testing laboratory employing technicians certified according to ANSI/NETA ETT prepare it.

a. Perform the short circuit portion of the Study in accordance with ANSI/IEEE C37.10, ANSI/IEEE C37.13, ANSI/IEEE 141, ANSI/IEEE 242, and ANSI/IEEE 399.

1) Calculate short circuit momentary duty values and interrupting duty values on the basis of the following short circuit conditions at every distribution transformer, secondary and primary terminal at every bus in every switchboard, motor control center, distribution panelboard, branch circuit panelboard and at terminals of utilization equipment whether it be Electrical, Process, HVAC, Plumbing or Instrumentation that is either 480V or 208V, 3-phase and rated 15 Amps or higher. Include:
a) Single line to ground fault.
b) Bolted three-phase line to ground fault.
c) Double line (line to line) to ground fault.

b. Perform the arc flash portion of the Study for the electrical distribution equipment in accordance with NFPA 70E and ANSI/IEEE 1584.

1) Perform the analysis under worst-case arc-flash conditions; and if applicable, describe in the final report how these conditions differ from worst-case bolted fault conditions.
2) Perform separate analysis for operation from the normal utility source(s) and operation from the stand-by generator(s). Present results for both operating conditions in the reports.
3) Provide the following items for each circuit and arc location analyzed:
a) Printed hardcopy of calculations performed.
b) Arcing fault magnitude.
c) Device clearing time.
d) Duration of arc.
e) Arc flash boundary distances.

f) Working distance.
g) Arc flash incident energy.
h) Hazard risk category.
i) Personal-protective equipment classes.
j) Arc flash warning labels as specified in Section 26 05 53.
k) Provide separate labels for operation from the normal utility source(s) and operation from the stand-by generator(s).
l) Recommendations and potential options for arc flash energy reduction to reduce the Incident Energy levels where they are calculated to be over the 40 cal/cm2. Refer to and coordinate with AW Engineering Standards for conducting this work.
m) Maintenance procedures/guidelines in accordance with the requirements of NFPA 70E for the Owner.

c. Coordinate protective devices with systems and equipment by providing the necessary calculations and logic decisions required to select or to check the selection of power fuse ratings, ratios and characteristics of associated current transformers, and breaker trip characteristics and settings and distribution system fuses.
1) Provide coordination plots for phase and ground protective devices on a system basis.
a) Adhere to National Electrical Code restrictions, and maintain proper coordination.
b) Provide a sufficient number of separate curves to clearly indicate the coordination achieved.
2) Either computer-generate or hand-draw time-current characteristics of the specified protective devices on log-log scale plots.
a) Include complete titles, the respective one-line diagram and identifying legends, associated relays or fuse characteristics, significant motor starting characteristics, complete operating bands of low voltage circuit breaker trip curves and fuses.
b) Indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush, through-fault current duration per ANSI/IEEE C57.12.59, dry-type transformers withstand, cable thermal overcurrent withstand limits, symmetrical fault currents and motor full load current, locked-rotor current, and magnetizing inrush in the coordination plots.
3) Provide the selection and settings of the protective devices separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connection, manufacturer and type, range of adjustment, and recommended settings.
a) Use the information from the Study to obtain optimum device protective and coordination performance.

2. In addition to the information common to the studies as listed in **Subparagraph 1.04.A.3**, include the following information specific to short circuit, arc-flash, and protective device coordination distortion only in the Short Circuit, Arc-Flash, and Protective Device Coordination Study:
a. Complete short circuit and protective device coordination studies, including coordination plots, for the following electrical distribution systems serving the entire facility:
1) Utility Voltage Service.
2) Not used
3) Utility low voltage service system.

4) Standby low voltage generator system.
5) Not used
6) Low voltage 208Y/120 volts, 3 phase, 4 wire distribution systems.
7) Downstream systems devices connected through isolation transformers.

b. Power company supply and network characteristics, including the following:
1) The base quantities selected.
2) Source impedance data and impedance diagrams.
3) One-line diagrams.
4) Calculation methods and tabulations.
a) Include short circuit tabulations of the fault impedance, X to R ratios, asymmetry factors, KVA, symmetrical and asymmetrical fault currents, and all multiplying factors.
5) Conclusions and recommendations.

c. Motor starting characteristics for motors 50 HP and above.
1) Study reduced voltage motor timer settings to determine the correct coordinated settings and the correct tap setting based on the motor torque curve, load torque curve, and motor WK2 and load WK2 to minimize undesirable influence on the distribution system.

d. Capacitor switching transient surge analysis.
1) Indicate effects the capacitor switching has on the electrical power distribution system.
2) If adverse effects on the power distribution system are indicated by the study, submit corrective recommendations with the short circuit and protective coordination study for review by the Engineer.

e. Provide sufficient information in the study to ensure adequate protection of the cables, transformers, and other equipment; to indicate proper coordination between fuses and circuit breakers; and to determine areas of the system in which additional coordination may be required.

3. Submit Short Circuit, Arc-Flash, and Protective Device Coordination Study information with the equipment submittals for review by the Engineer.

E. Harmonic Distortion Study:

1. Prepare the Harmonic Distortion Study under the supervision of a Professional Engineer licensed in the state of New York, or have it prepared by a NETA certified electrical testing laboratory employing technicians certified according to the NETA Standard for Certification of Electrical Testing Technicians.

a. Perform the harmonic distortion study in accordance with the requirements of ANSI/IEEE 519.

b. Ensure that the maximum permissible harmonic distortion of the electrical system complies with the limitations in ANSI/IEEE 519, ANSI/IEEE 18, ANSI/IEEE 399, and IEEE 1036; and at the Point-of-Common-Coupling (PCC) ensure that it meets or exceeds the following criteria:
1) Voltage Distortion:
a) Ensure that the maximum voltage distortion as a percentage of the fundamental harmonic does not exceed the values in Table 26 05 00-1.

Table 26 05 00-1 Maximum Voltage Distortion - Percent of Fundamental	
Harmonic	**Percent Harmonic Voltage Distortion (THD)**

b)

	Normal Power Source	Emergency Generator Source
Total	5	5
One Harmonic	3	3

2) Current Distortion:
   a) Ensure that the maximum current distortion as a percentage of the fundamental harmonic does not exceed the values in Table 26 05 00-2, where the following definitions apply:
      (1) I_{sc} is the maximum short circuit current at the Point-of-Common-Coupling (PCC).
      (2) I_L is the maximum load current (fundamental frequency at PCC).
      (3) THD_C is the total harmonic current distortion.

Table 26 05 00-2 Maximum Current Distortion as a Percent of the Fundamental Harmonic

I_{sc}/I_L	Harmonic Order (Odd Harmonics*)					
	2-10	**11-16**	**17-22**	**23-34**	**35 UP**	**THD_C**
<20**	4.0	2.0	1.5	0.6	0.3	5.0
20-50	7.0	3.5	2.5	**1.0**	0.5	8.0
50-100	10.0	4.5	4.0	1.5	0.7	12.0
100-1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	10.0

* Even harmonics are limited to 25 percent of the odd harmonic limits in Table 26 05 00-2.

**All power generation equipment is limited to these values of current distortion, regardless of actual I_{sc}/I_L.

3) Notch Area:
   a) Ensure that the maximum notch area as defined in Figure 10.1 of ANSI/IEEE 519 does not exceed the following values:
      (1) For a maximum voltage distortion of 3 percent on 480-volt systems: 16,400 volt-microseconds.
      (2) For a maximum voltage distortion of 5 percent on 480-volt systems: 22,800 volt-microseconds.
      (3) For other than 480-volt systems multiply the notch area by V/480, where V is the voltage of the system.

4) Notch Depth:
   a) Ensure that the maximum notch depth as defined in Figure 10.1 of ANSI/IEEE 519 does not exceed the following values:
      (1) For a Total Harmonic Distortion (THD) of 3 percent: 10 percent.
      (2) For a Total Harmonic Distortion (THD) of 5 percent: 20 percent.

5) Telephone Interference:
   a) Ensure that the telephone interference, expressed as the I·T product defined in ANSI/IEEE 519 and the following, does not exceed 10,000:
      (1) I is the rms magnitude of the current in amperes.
      (2) T is the Telephone Influence Factor, TIF, a dimensionless quantity indicative of the waveform.

6) Limits of Flicker:
   a) Ensure that flicker, the magnitude of the voltage variation, does not exceed the limits shown in Figure 10.3 of ANSI/IEEE 519.

2. In addition to the common information required for all specified studies as listed in Subparagraph 1.04.A.3, include the following information specific to harmonic distortion only in the Harmonic Distortion Study:
   a. Total Harmonic Distortion (THD), each harmonic component up to and including the 35th harmonic, and the amount of each harmonic component at each of the following:
      1) Points-of-Common-Coupling between feeders to drives and feeders' distribution equipment buses,
      2) The main service.
      3) The generator terminals.
      4) The utility high voltage line at the plant boundary.
   b. Telephone Influence Factor for telephone service to the plant.
   c. The magnitude of the voltage distortion, current distortion, and telephone interference at each Point-of-Common-Coupling (PCC), including individual harmonics up to and including the 35th harmonic, the Total Harmonic Distortion (THD) on the system, and derating factors affecting equipment.
      1) Hardware contributions must include harmonics caused by any variable speed drives supplied under this Contract.
   d. Predicted voltage distortion, current distortion, and telephone interference in the electrical distribution system at each Point-of-Common-Coupling (PCC), utility service point, uninterrupted power supply (UPS), and primary of transformers having a 120/208 volt secondary.
      1) Provide calculations for the cases when one or a combination of variable frequency drive units are in operation.
   e. KVAC loadings, RMS current and peak voltage, the power factor correction capacitors within the plant, and the power factor correction capacitors located within 5 miles of the plant on power company lines feeding the plant.
      1) List KVAC loadings in percent.
   f. An analysis of capacitor switching that indicates the effects such switching has on the voltage distortion, current distortion, and telephone interference in the electrical distribution system at each Point-of-Common-Coupling (PCC), utility service point, uninterrupted power supply (UPS), and primary of transformers having a 120/208 volt secondary.
      1) Include the effects of harmonics on capacitors.
      2) If adverse effects on the power distribution system are indicated by the study, submit corrective recommendations with the harmonic distortion study for review by the Engineer.
   g. Heat loadings of equipment expressed as a percent of $V_{rms}2$ to rated V_L2 for equipment connected to motor control Center (MCC) buses.

F. Motor Overload Relay and Branch Circuit Overcurrent Protective Device Schedule
   1. Prepare and submit a Motor Overload Relay and Branch Circuit Overcurrent Protective Device Schedule that provides all information needed to determine proper settings.
   2. Obtain the actual horsepower, service factor, and full load running current for each motor on the project that is rated over one-eighth horsepower.

G. Electrical Safety Operating Diagrams:
   1. Prepare and submit one-line Electrical Safety Operating Diagrams for the electrical system.
      a. Make the diagrams similar to the diagrams shown in the article on Safety Electrical One-Line Diagrams in the Electrical Safety Handbook, or in any other nationally recognized style.

1) Show outlines of equipment using a line weight that contrasts with the line weight of wiring.
2) Use heavier of line weights for buses; and use different line weights for each voltage level, increasing the line weight for increasing voltage.
3) Omit ratings, but include the voltage levels of all buses; and include equipment designations and their common names.
4) Use symbolism similar to that on the Contract Drawings or conforming to ANSI standards, such as ANSI/NECA 100, ASME Y14.2M, ASME Y14.24M, ASME Y14.34M, ASME Y14.35M, and ASME Y14.100.
5) Provide a legend on each sheet.

2. Create a separate diagram for each building or structure showing the following items:
   a. The electrical system for the building or structure, complete and showing all sources supplying power to the building or structure from the first disconnecting device upstream of the building or structure.
   b. Overcurrent protective devices, disconnecting devices, and all wiring between them and equipment buses for the following:
      1) Devices and buses within motor control centers.
      2) Devices and buses within switchboards.
      3) Main devices and devices disconnecting external power from each motor starter.
      4) Main devices and buses in each panelboard.
      5) Main devices on engine generator sets.
      6) Feeder overcurrent protective devices on engine generator sets.
   c. Include branch circuit overcurrent protective devices within panelboards that supply the following items:
      1) Feeders to other panelboards and to transformers.
      2) Motor starters.
      3) Control panels.
      4) Motor control centers.
      5) Transient voltage surge suppressors.
      6) Loads larger than 5 kVA or 5 horsepower, or rated over 300 Volts.
   d. Equipment:
      1) Transformers external to equipment.
      2) Motor starters for motors over 1 horsepower and their disconnecting devices.
      3) Utilization equipment that is rated larger than 5 kVA or 5 horsepower, or is rated over 300 Volts, and its disconnecting devices.
      4) Motors rated over 1 horsepower and their disconnecting devices.
   e. Interconnecting wiring between equipment.
   f. Sources of all power upstream of the building or structure, and devices that disconnect this power without ratings.
3. For each device in the building or structure show the first item downstream of that device whether or not the downstream item is in the same building or structure.
4. Submit the Electrical Safety Operating Diagrams for approval.
   a. After approval by Engineer, provide an electronic copy of all Electrical Safety Operating Diagrams on a CD ROM disc in AutoCAD (dwg) or Adobe (pdf) format.

1.5 SUBMITTALS

A. Submit the following information for approval in accordance with the requirements of Section 01 33 00, Submittal Procedures:

1. Product Data:
   a. Submit Product Data, including catalog cuts, for all products provided for the electrical work of this Contract and as specified in other Sections.
      1) Clearly indicate the usage of each product on each submittal.
2. Shop Drawings:
   a. Submit Shop Drawings for the electrical work of this Contract as specified in other Sections.
3. Quality Assurance/Control Submittals:
   a. Design Data:
      1) Short Circuit, Arc Flash and Protective Device Coordination Study Reports:
         a) Preliminary Short Circuit, Arc Flash and Protective Device Coordination Study.
         b) Final Short Circuit, Arc Flash and Protective Device Coordination Study.
         c) CD ROM disc containing:
            (1) The complete computer program model(s) used in performing the Short Circuit, Arc Flash, and Protective Device Coordination Study. Provide with both the Preliminary and Final Study Reports.
            (2) Spreadsheet in MS Excel format that tabulates all analyzed scenarios with accompanying results. Provide with both the Preliminary and Final Study Reports.
      2) Harmonic Distortion Study Reports:
         a) Preliminary Harmonic Distortion Study.
         b) Final Harmonic Distortion Study.
         c) CD ROM disc containing:
            (1) The complete computer program model(s) used in performing the Harmonic Distortion Study. Provide with both the Preliminary and Final Study Reports.
            (2) Spreadsheet in MS Excel format that tabulates all analyzed scenarios with accompanying results. Provide with both the Preliminary and Final Study Reports.
      3) Final Project Report, with final Short Circuit, Arc Flash and Protective Device Coordination Study and Harmonic Distortion Study Reports.
      4) Motor Overload Relay and Branch Circuit Overcurrent Protective Device Schedule.
      5) Electrical Safety Operating Diagrams:
         a) Hard copies for approval.
         b) CD ROM disc in AutoCAD (dwg) or Adobe (pdf) format.
   b. Certificates:
      1) Testing agency quality verification that all products meet requirements or manufacturer disclaimer statements.
   c. Qualification Statements:
      1) Testing agency qualifications.
4. Closeout Submittals:
   a. Operation and Maintenance Manuals.
   b. CD ROM disc containing the complete computer program model(s) used in performing the Circuit, Arc Flash, Protective Device Coordination, and Harmonic Distortion Studies, updated to reflect the final as-built condition.

1.6 SUBSTITUTIONS, BASIS OF DESIGN, AND ACCEPTABLE MANUFACTURERS

A. All substitutions to identified materials or equipment shall comply with the applicable requirements of Division 1. In any case of conflict between such requirements of Division 1 and this paragraph, the more stringent requirements shall govern.

B. Whenever an item of material or equipment is identified by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function and quality required. Unless the identification or description contains or is followed by words reading that no like, equivalent or "or- equal" item or no substitution is permitted, material or equipment of other Suppliers may be proposed.

C. Where substitutions to identified items are permitted, any proposed substation or alternate must fully comply with the following in order to be considered by the Engineer:
   1. Be of a reputable manufacturer,
   2. Be fully compliant with the requirements of this Section and the Drawings,
   3. Be fully compatible with all interfacing items and work, and with the installation environment,
   4. Be appropriate (as determined by the Engineer) for the proposed application, and
   5. Be equivalent (as determined by the Engineer) in character, performance, and quality to any identified Basis of Design.

D. Where a specific manufacturer or product is identified as the Basis of Design or listed first in a list of acceptable manufacturers, the overall project design is based on the identified manufacturer or product. If the Contractor elects to substitute a manufacturer or product which differs from the identified Basis of Design, the Contractor shall bear all efforts and costs of any design changes necessary in order to achieve finished work which is equal in character, performance, and quality to the original design depicted in the Contract Documents. Such changes shall include, but not necessarily be limited to: changes to ratings and/or features of other equipment, changes to material sizes and/or types, new material and/or equipment, and changes to structural and/or architectural features (including room sizes). Approval by the Engineer of a proposed substitute item shall not relieve the Contractor of this responsibility.

E. The listing of specific manufacturers is solely intended to identify reputable manufacturers who are known to provide quality products of the general type specified. Such listing is in no way intended to imply that the identified manufacturers product(s) have been verified to satisfy the specified requirements, or to be equivalent to any identified Basis of Design manufacturer. Nor does such a listing imply acceptance of products which do not meet the specified requirements, ratings, features, dimensions, and functions as indicated.

1.7 QUALITY ASSURANCE

A. Qualifications:
   1. Testing Agency Qualifications:
      a. Use a NETA accredited testing agency, or approved equal, that is accredited for the region in which the Contract work is performed.
      b. Submit the testing agency's qualifications to the Engineer for approval.

B. Regulatory Requirements:
   1. Perform all electrical work in conformance with the requirements of NFPA 70, the National Electrical Code.

C. Certifications:
1. Submit evidence with all Product Data that the products represented meet testing agency quality verification requirements, including agency listing and labeling requirements.
a. Such evidence may consist of either a printed mark on the data or a separate listing card.
b. Submit a written statement from those product manufacturers that do not provide evidence of the quality of their products that indicates why an item does not have quality assurance verification.
1) Such statements provided in lieu of quality assurance verification are subject to the acceptance of the Owner and the Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to the work site in accordance with the requirements of Section 26 05 00.
1. Deliver materials and equipment in a clean condition.
a. Provide packaging that plugs, caps, or otherwise seals openings both during shipping and temporary storage.
2. Provide equipment needed for unloading operations, and have such equipment on the work site to perform unloading work when the material and equipment is delivered.
a. If possible, clearly identify pick-points or lift-points on electrical equipment crating and packaging.
b. In the absence pick-points or lift-points on equipment crating and packaging, identify pick-points or lift-points on the equipment itself.

B. Handle materials and equipment in accordance with the requirements of Section 26 05 00.
1. Handle materials and equipment in accordance with manufacturer's written instructions.
2. When unloading materials and equipment, provide special lifting harnesses or apparatus as required by manufacturers.

C. Store electrical materials and equipment, whether on-site or off-site, in accordance with Section 26 05 00 and the following:
1. Follow the manufacturer's written instructions for storing the items.
2. Store electrical equipment and products under cover.
a. Except for electrical conduit, store electrical equipment and products in heated warehouses or enclosed buildings with auxiliary heat and that provide protection from the weather on all sides.

1.9 SYSTEM STARTUP

A. Energize the following items in the presence of the Engineer:
1. Process instrumentation.
2. Equipment rated over 300 Volts.
3. Equipment rated over 1-horsepower.

B. Startup the following items in the presence of the Engineer:
1. Instrumentation.
2. Process equipment.

1.10 MAINTENANCE

A. Operation and Maintenance Manuals:
   1. Prepare Operation and Maintenance Manuals in conformance with the requirements of Metro North, other Contract requirements, and as follows:
      a. Organize Operation and Maintenance Manuals by Specification Section and equipment number as designated on the Contract Drawings.
      b. Include suppliers, supplier addresses, and supplier telephone numbers for the equipment and products furnished.
   2. 60 days prior to the request for final payment, prepare and submit two copies of the proposed Operation and Maintenance Manuals to the Engineer for approval.
   3. Upon approval of the proposed Operation and Maintenance Manuals, submit six corrected copies as follows:
      a. Submit one set to the Engineer.
      b. Place one set in the spare parts and fuse cabinet in the new electrical service building
      c. Deliver the remaining four copies to the Owner.
   4. Insert final record drawings in each set of Operation and Maintenance Manuals at Project Closeout.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Grounding and Bonding Materials:
   1. Provide grounding and bonding materials in accordance with the requirements of Section 26 05 26.

B. Hangers and Supports:
   1. Provide hangers and supports for electrical equipment in accordance with the requirements of Section 26 05 28.

C. Electrical Identification Materials:
   1. Provide electrical identification materials in accordance with the requirements of Section 26 05 53.

D. Wire and Cable:
   ~~1. Provide medium-voltage electrical wire, cable, and accessories in accordance with the requirements of Section 26 05 13~~
   2. Provide low-voltage electrical wire, cable, and accessories in accordance with the requirements of Section 26 05 19.

E. Conduit and Raceway:
   1. Provide conduit and raceway as indicated, as appropriate for the application per NFPA 70, and in accordance with the following:
      a. Conduit and Tubing: Provide electrical conduit and tubing in accordance with the requirements of Section 26 05 33.13.
      b. Surface Raceway: Provide electrical surface raceway in accordance with the requirements of Section 26 05 33.16.
      ~~c. Wireway and Fittings: Provide electrical wireway and fittings in accordance with the requirements of Section 26 05 36.~~

~~d. Cable Trays and Fittings: Provide electrical cable trays and fittings in accordance with the requirements of Section 26 05 36.~~

F. Wiring Devices:
1. Provide electrical wiring devices in accordance with the requirements of Section 26 27 26.

2.2 SHOP FINISHING

A. For electrical equipment, factory-apply paint and coating systems that at a minimum meet the requirements of the NEMA ICS 6 corrosion-resistance test and the additional requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 POSTING OF ELECTRICAL SAFETY OPERATING DIAGRAMS

A. Post a 24" x 36" hard paper copy of the Electrical Safety Operating Diagram in each building or structure. Diagrams shall be posted on a wall in metal frame under 1/8" Lexan in clear view of the devices disconnecting all power from the building or structure.

3.2 INSTALLATION

A. Field-Applied Finishes:
1. Except for factory-finished items that have been completely finished with factory- applied primer and final finish coatings, finish installed electrical materials, equipment, apparatus, and items in the field in accordance with the requirements of Section 09 90 00.
   a. Apply paint material matching the composition of the factory-applied products.
      1) Obtain factory-supplied paint for this work whenever available.
   b. Comply with the paint manufacturer's instructions for mixing, thinning, surface preparation, application, spreading rate, drying time, and environmental limitations concerning application of the paint.
   c. Apply paint in such a manner so that the finished appearance will match as nearly as possible the factory finish.
      1) Poorly applied paint may be required to be repaired and re-applied by the Contractor in accordance with Article 3.02 at no additional cost to the Owner.
2. Coordinate the painting of large areas with the Engineer to minimize the duration of exposure of other workers to toxic paint fumes.

3.3 REPAIR/RESTORATION

A. If the factory finish of factory-finished items is damaged for any reason, refinish the item.
1. If an item that has several surfaces has damage on one surface, refinish the entire damaged surface.
   a. Surface Preparation:
      1) Outside the damaged area, lightly sand the entire surface and perform additional sanding to profile the damaged paint edge.
      2) Prepare the surfaces of damaged areas in accordance with SSPC-SP 2.

3.4 FIELD QUALITY CONTROL

A. Contractor shall perform electrical testing as detailed in Section 26 05 63 and in each Specification Section.

B. Contractor shall have electrical work inspected as required by the local Authority Having Jurisdiction (AHJ).
   1. Submit a copy of the certification of inspection with the final project closeout documents, and post the original in the electrical room on-site protected by a metal frame with a protective plate glass cover.

C. The quality of finishing and refinishing work is subject to approval by the Engineer.

3.5 MANUFACTURERS' FIELD SERVICES

A. Contractor shall provide the services of a qualified field engineer and necessary tools and equipment to test, calibrate, and adjust the protective relays and circuit breaker trip devices as recommended in the Final Project Report of the power system study.

END OF SECTION

SECTION 26 05 19 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for furnishing, installing, connecting, energizing, testing, cleaning, and protecting low voltage cable, shielded cable, and accessories.

B. Related Sections:
   1. Section 01 33 00 - Submittal Procedures.
   2. Section 26 05 00 – Common Work Results for Electrical
   3. Section 26 05 26 - Grounding and Bonding.
   4. Section 26 05 53 – Identification for Electrical Systems.
   5. Section 26 05 63 – Acceptance Testing for Electrical Systems.
   6. Section 26 05 33.16 – Boxes for Electrical Systems

1.2 REFERENCES

A. American Society for Testing Materials (ASTM):
   1. ASTM B 8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

B. Institute of Electrical and Electronic Engineers (IEEE):
   1. IEEE 383 - Standard for Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations.
   2. IEEE 1202 - Standard for Flame-Propagation Testing of Wire and Cables.

C. National Electrical Manufacturer's Association (NEMA):
   1. NEMA WC 26/EEMAC 201 - Binational Wire and Cable Packaging Standard.
   2. ANSI/NEMA WC 57 - Standard for Control, Thermocouple Extension, and Instrumentation Cables.

D. National Fire Protection Association (NFPA):
   1. NFPA 70 - National Electrical Code (NEC).

E. Underwriter's Laboratories, Inc. (UL):
   1. UL 13 - Standard for Power-Limited Circuit Cables.
   2. UL 1277 - Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
   3. UL 1569 - Standard for Metal-Clad Cables.
   4. UL 1581 - Reference Standard for Electrical Wires, Cables, and Flexible Cords.
   5. UL 1685 - Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables.
   6. UL 2250 - Standard for Instrumentation Tray Cable.

F. Insulated Cable Engineers Association (ICEA):
1. ICEA T-29-520 - Vertical Cable Tray Flame Test @ 210,000 BTU.

1.3 DESIGN REQUIREMENTS

A. Conductors in Raceway and Conduit Systems:
1. Provide conduit systems for installing the wiring that is outside of equipment.
2. Except for raceway or conduit for control wires or where otherwise indicated on the Contract Drawings, design raceway and conduit systems so that the maximum number of low-voltage current carrying conductors (per NFPA 70, Article 310) in each raceway or conduit does not exceed three, plus a ground.

B. Cable Tension Design Requirements:
1. Design conduit runs so that the tension limits set by the wire and cable manufacturers will not be exceeded.
a. Provide additional pulling points as required to limit the tension to acceptable levels.
2. Generate and submit tension cable pulling calculations for all underground power runs.
a. Include pull loads, tension, and safety factors for all cables with the calculations.

C. Product Data and Catalog Cuts:
1. Submit low-voltage ground, power, and control wiring product data as listed below for the products provided as the Work of this Section; and clearly indicate the usage of each product on the data submitted.
a. Wires and cables.
b. Lugs.
c. Connectors.
d. Tapes.
e. Pulling lubricant.
f. Tools used to crimp connectors.

D. Use of Trade Names:
1. The use of trade names within the Contract Documents is intended to establish the basis of design and to illustrate the constructability and level of quality required.
a. The use of trade names is not intended to exclude other manufacturers whose products are equivalent to those named, subject to compliance with Contract requirements.

1.4 SUBMITTALS

A. Submit the following information to the Engineer for approval in accordance with the requirements of Section 01 33 00, Submittal Procedures:
1. Product Data:
a. Wires and cables.
b. Lugs
c. Connectors.
d. Tape.
e. Pulling lubricant.
2. Samples:
a. Wire samples.
3. Quality Assurance/Control Submittals:
a. Design Data.

1) Tension cable pulling calculations for all underground power runs.

b. Certificates.
1) Testing agency/quality verification.

c. Manufacturers Instructions.
1) Cable manufacturer's recommendations.

d. Qualification Statements.
1) Documented experience of the installing firm.
2) Qualifications of the licensed electricians supervising the Work.

1.5 QUALITY ASSURANCE

A. Qualifications:
1. Installer Qualifications:
a. To install the Work of this Section, employ the services of a firm specializing in installing wire, cable, and accessories, and that has a minimum of 3 years experience doing so.
1) Submit the documented experience of the firm installing the wire, cable, and accessories.
b. To supervise installation of the Work of this Section, employ licensed electricians.
1) Submit the qualifications of the licensed electricians supervising the Work of this Section.

B. Regulatory Requirements:
1. Perform the Work of this Section in accordance with the requirements specified in NFPA 70, and to all other applicable state, local, and national governing codes and regulatory requirements.

C. Certifications:
1. Provide products that are listed and labeled by Underwriters Laboratory, approved by Factory Mutual, or certified as meeting the standards of UL by the Electrical Testing Laboratory (ETL) for the location installed in, and the application intended, unless products meeting the requirements of these testing laboratories are not available or unless standards do not exist for the products.
a. Provide copper conductors listed and labeled by UL for all wiring.
2. Submit evidence of testing agency/quality verification, listing, and labeling for each product with the submitted product data either by providing a printed mark on the data or by attaching a separate listing card.
a. For items without such evidence, submit a written statement from the product manufacturer that indicates why it does not have quality assurance verification.

D. Field Samples:
1. Submit one 36-inch long sample of each type of wire to be used.

1.6 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
1. Imprint insulated conductors with the date of manufacture, the wire type, and the manufacturer.
2. Package wire and cable in conformance with the requirements of NEMA WC 26/EEMAC 201.

3. Protect items from damage during delivery, handling, and installation.
    a. Comply with the cable manufacturer's recommendations for inspection, handling, storage, temperature conditioning, bending and training limits, pulling limits, and calculation parameters for installing cable.
    b. Submit the cable manufacturer's recommendations for inspection, handling, storage, temperature conditioning, bending and training limits, pulling limits, and calculation parameters for installing cable.

B. Acceptance at Site:
1. Wire and cable manufactured more than 12 months before delivery to the Site is unacceptable for use under this Contract, and will be rejected.

C. Storage and Protection:
1. Store products indoors on blocking or pallets.
2. Protect items from damage during storage.

1.7 PROJECT ENVIRONMENTAL REQUIREMENTS

A. Install armored instrumentation cable only when the temperature is above -40 degrees Celsius.

1.8 MAINTENANCE

A. Operation and Maintenance Manuals:
1. Include product data for the products provided as the Work of this Section in the Operation and Maintenance Manuals submitted with the record drawings at project closeout in accordance with Metro North standards.

PART 2 - PRODUCTS

2.1 LOW VOLTAGE CONDUCTORS

A. Conductor Design Requirements:
1. Provide conductors of the proper size and ampacity ratings based on Article 310 of NFPA 70.
    a. Provide copper conductors that have 98 percent conductivity.
    b. Unless otherwise indicated on the Contract Drawings, at a minimum provide conductors of the following American Wire Gauge (AWG) sizes:
        1) For power and branch feeder circuits: 12 AWG.
            a) For power and branch feeders, provide solid or stranded copper low-voltage conductors for sizes up to and including 10 AWG, provide stranded copper low-voltage conductors for 8 AWG and larger sizes.
        2) For control circuits: 14 AWG.
        3) For alarm and status circuits: 14 AWG.
        4) For single conductor instrument wiring: 14 AWG.
        5) For multiple conductor instrument wiring: 16 AWG.

B. Insulation Design Requirements:
1. Provide low voltage ground, power, and control wiring having the proper insulation types as follows:

Addendum 6

a. For exterior, wet, and damp locations, including NEMA 4X locations: Type XHHW-2.
b. For underground wiring:
1) For sizes 14 AWG through 10 AWG: Type XHHW-2.
2) For sizes 8 AWG and larger: Type RHW-2 or XHHW-2.
c. For wiring that is wholly in dry indoor locations: Type XHHW-2, or dual-rated Type THHN/THWN.
d. For ground wires: THW may be used at the Contractor's option.

2. Color Coding of Wires
a. Insulation shall be factory colored per Tables 16122-1, 16122-2 and/or 16122-3 below. The use of tape for color coding is prohibited.

C. Manufacturers
1. Acceptable Manufacturers:
a. Continental Wire & Cable Company
b. SouthWire
c. General Cable
d. Okonite Co.
e. Or Approved Equal

2.2 MATERIALS

A. 600 Volt Rated Multi-Conductor Cable:
1. Provide multi-conductor cable that is suitable for use indoors or outdoors; exposed or concealed; as open wiring; in any raceway, underground duct, or cable tray; direct buried; or embedded in concrete.
a. Provide cable that is UL listed as Type MC in compliance with the requirements of UL 1569, and is UL listed for 90 degrees Celsius dry or wet, for direct burial, for cable tray use, and as sunlight resistant.
2. Assemble the cable with non-hygroscopic fillers and binder tape.
a. Insulated Conductors:
1) Provide uncoated stranded copper conductors, complying with the requirements of ASTM B 8 for Class B conductors.
2) Provide cross-linked polyethylene type XHHW-2 insulation rated for 600 volts.
b. Grounding Conductors:
1) Provide uninsulated copper conductors.
c. Cover the overall assembly with a single strip of interlocked aluminum tape, and then apply an outer final jacket of black flame-retardant PVC.
3. Manufacturers:
a. General Cable Technologies Corporation,
b. The Okonite Company,
c. Or Approved Equal.

B. Tray Cable:
1. Provide tray cable that is suitable for use indoors or outdoors; in any raceway, underground duct, or cable tray; or direct buried.
a. Provide cable that is UL listed as Type TC in compliance with the requirements of UL 1277, and is UL listed for 90 degrees Celsius dry or wet, for direct burial, for cable tray use, and as sunlight resistant.
2. Assemble the cable with non-hygroscopic fillers and binder tape.
a. Conductors:

1) Provide uncoated stranded copper conductors, complying with the requirements of ASTM B 8 for Class B conductors.
2) Provide the following number and size of conductors where indicated in the Contract Documents:
a) For power cables:
(1) 3-conductor, Number 12 AWG.
(2) 4-conductor, Number 12 AWG.
(3) 3-conductor, Number 10 AWG.
(4) 4-conductor, Number 10 AWG.
b) For status/control cables:
(1) 4-conductor, Number 16 AWG.
(2) 4-conductor, Number 14 AWG.

b. Insulation:
1) Provide type XHHW-2 insulation rated for 600 volts that is color coded according to ANSI/NEMA WC 57 Method 1.

c. Cover the overall assembly with a cable jacket constructed of flame- retardant chlorinated polyethylene (CPE).

3. Manufacturers:
a. General Cable Technologies Corporation, Flame-Retardant Ethylene Propylene (FREP®) XHHW-2 VW-1,
b. Or Approved Equal.

C. Metal Clad Cable:
1. Bare soft annealed copper conductors, solid or Class B stranded per ASTM B8. Conductors shall be solid copper in sizes up to and including No. 10 AWG. For sizes No. 8 AWG and larger, conductors to be stranded copper.
2. Type THHN insulation, 600 volts, color coded.
3. Insulated green copper grounding conductor. Meets or exceeds requirements of NEC Table 250-95.
4. Assembled per UL 1569 with non-hygroscopic fillers and binder tape.
5. Close fitting interlocked galvanized steel armor per UL 1569.
6. UL listed as type MC cable.
7. UL listed for cable tray use.
8. Cable shall be suitable for environmental air handling space installation.
9. Imprint insulated conductors with the date of manufacture, wire type, and manufacturer. Wire and cable manufactured more than 12 months before delivery to the job site shall not be used.
10. The only permitted use of Metal Clad cable is for final whip-connections to lighting fixtures above suspended ceilings. Length shall not exceed 72 inches.
11. Acceptable Manufacturers:
a. AFC Cable Systems.
b. Or Approved Equal.

D. Shielded Instrumentation Tray Cable (2/C Cable):
1. Provide 100 percent shielded, two-conductor, 16 AWG twisted pair instrumentation tray cable.
a. Provide cable that is UL listed as Type TC in compliance with the requirements of UL 1277, and having a 90 degree temperature rating.
b. Conductors:
1) Provide stranded tin-coated copper conductors.
c. Shielding:

1) Provide aluminum-polyester foil shielding that incorporates an 18 AWG stranded tinned copper drain wire.

d. Insulation:

1) Provide insulation rated for 600 volts and consisting of polyvinyl chloride (PVC) with a nylon overcoat all covered by an overall PVC jacket.

2. Manufacturers:

a. Belden, Inc., Part Number 9342,
b. Alpha Wire
c. West Penn
d. Or Approved Equal

E. Shielded Instrumentation Cable (2/C Cable):

1. Provide 100 percent shielded, two-conductor, 16 AWG twisted pair cable.

a. Provide NFPA 70 (NEC) Class CL2 cable that is UL (recognized) Style 20253, and has a 90 degree temperature rating.

b. Conductors:

1) Provide stranded (19 x 29 AWG) tin-coated copper conductors.

c. Shielding:

1) Provide aluminum-polyester foil shielding that incorporates an 18 AWG stranded tinned copper drain wire.

d. Insulation:

1) Provide color coded insulation rated for 600 volts and consisting of polyethylene covered by an overall PVC jacket.

2. Acceptable Manufacturers:

a. Belden, Inc., Part Number 8719
b. Alpha Wire
c. West Penn
d. Or Approved Equal

F. Armored Instrumentation Cable:

1. Provide armored instrumentation cable consisting of a single pair with left-hand lay and an overall shield suitable for use indoors or outdoors; in any raceway, underground duct, or cable tray; or direct buried.

a. Provide cable that is UL listed as Type PLTC (Power-Limited Tray Cable) and Power-Limited Circuit Cable for use in Class II or III circuits in accordance with Articles 725 and 727 of NFPA 70, and is UL listed for 90 degrees Celsius dry or wet, for direct burial, for cable tray use, and as sunlight resistant.

1) Provide cables complying with UL requirements for Types CL2 and CL3.

b. Conductors:

1) Provide 7-strand concentric 16 AWG bare soft annealed copper conductors complying with the requirements of ASTM B 8 for Class B conductors.

c. Cable Shielding:

1) Provide a shield consisting of a 1.35 mil blue double faced aluminum/synthetic polymer backed tape overlapped to provide 100 percent coverage, and a 7-strand tinned copper drain wire, two sizes smaller than the conductor

d. Insulation:

1) Provide high dielectric strength, chemically cross-linked, color coded polyethylene insulation rated for 300 volts and that complies with the requirements of UL 13 and UL 2250.

a) Inner Jacket: Black, flame-retardant polyvinyl chloride (PVC).

b) C-L-X Sheath: Close fitting, impervious, continuous, welded, corrugated aluminum sheath that exceeds the equipment grounding conductor requirements of Section 250.122 of NFPA 70 (NEC).
c) Outer Jacket: Black, flame-retardant polyvinyl chloride (PVC).
2) Color Code: Black and white.
3) Nominal Thickness: 25 mils.

2. Acceptable Manufacturers:
a. The Okonite Company, C-L-X Type P-OS
b. Or Approved Equal.

G. Shielded RTD Cable for Interior Applications (3/C):
1. Provide cable which meets the following:
a. Cable fabricated using stranded (19 x 29 AWG) tin-coated copper conductors with polyethylene insulation, color coded conductor insulation and overall PVC jacket.
b. Cable 100 percent shielded, utilizing aluminum-polyester, incorporating a
c. #18 AWG tinned copper drain wire.
d. Cable UL (recognized) Style 2107 having a 300 volt insulation and 60 degree C temperature rating, three-conductor, twisted triad, #16 AWG.
e. NEC type CL3.
2. Acceptable Manufacturers:
a. Belden, Inc., Part Number 8618,
b. Alpha Wire
c. West Penn
d. Or Approved Equal

H. Shielded RTD Cable for Ductbanks (3/C):
1. Provide cable which meets the following:
a. Cable fabricated using stranded (7-strand) bare copper conductors with modified Ethylene Tetrafluoroethylene insulation, color coded conductor insulation and overall modified Ethylene Tetrafluoroethylene jacket.
b. Cable 100 percent shielded, utilizing aluminum-nylon-polyester tape, incorporating a #16 AWG tinned copper drain wire.
c. Cable UL listed as ITC/PLTC, CL2 and CL3, having a 300 volt insulation and 150 degree C temperature rating, three-conductor, twisted triad, #16 AWG.
d. Cable suitable for direct burial.
2. Acceptable Manufacturers:
a. Okonite, catalog number 264-45-4401.

2.3 ACCESSORIES

A. Cable Lubricant:
1. Provide cable lubricant specifically recommended by the cable manufacturer for cable pulling operations.
a. For rubber of plastic jacketed cables, provide soapstone, graphite, or talc cable lubricant.

B. Grounding Braid:
1. Provide conformable, all-metal (tinned copper wires), corrosion resistant, woven grounding braid having a high current-carrying capacity approximately that of 6 AWG wire, such as.
2. Manufacturers:

a. 3M, Scotch, Scotch® 25 Electrical Grounding Braid,
b. Plymouth
c. Permacel
d. Or Approved Equal.

C. Tapes:
1. Arc Proofing Tape:
a. Provide fire retardant arc proofing tape, such as Scotch® 77 Fire Retardant Electric Arc Proofing Tape, that is capable of protecting cables from fault arc generated heat and flames and of protecting adjacent wrapped cables and accessories exposed to fault arcs until limiting devices can interrupt the faulted circuit.
2. Vinyl Insulating Tape:
a. Provide UL-listed flexible polyvinyl chloride (PVC) backed insulating tape with a pressure sensitive adhesive, such as black Scotch® 33+ Vinyl Electrical Tape, that is resistant to abrasion, acids, alkalis, and copper corrosion; resistant to, hot, cold and wet weather; and resistant to damage from UV sunlight exposure.
3. Rubber Splicing Tape:
a. Provide highly conformable, linerless, self-bonding, ethylene rubber (EPR), high-voltage (through 69 kV) insulating tape formulated to provide excellent thermal dissipation of splice heat, and designed to insulate splices and terminate cables whose overload temperatures can reach 130 degrees Celsius, such as Scotch® 130C Linerless Rubber Splicing Tape.
4. Manufacturers:
a. 3M, Scotch
b. Plymouth
c. Permacel
d. Or Approved Equal.

D. Tubing:
1. Heat Shrinkable Tubing:
a. Provide flexible, flame retardant, polyolefin heat shrinkable thin wall tubing that has good resistance to common fluids and solvents, and has a high dielectric strength.
2. Waterproof Splice Kits:
a. Provide heat shrinkable thin wall polyolefin electrical cable splice kits.
3. Manufacturers:
a. Tyco Electronics, CGPT
b. Thomas & Betts Corp.
c. Or Approved Equal.

E. Wire and Cable Connections:
1. Grounding Connectors:
a. Provide grounding connectors conforming to the requirements of Section 26 05 26, Grounding and Bonding.
2. Connectors for Service Wires and Cables, and for Wires and Cables Larger Than Number 6:
a. Split Bolt Connectors or Compression Type Connectors:
1) Provide UL-listed split bolt connectors or compression type connectors for making parallel or butt splices of stranded copper wire.
2) Use companion preformed plastic insulating covers or tape insulation conforming to NFPA 70 (NEC) requirements.
b. Mechanical compression connectors:

1) Provide mechanical compression connectors that are capable of connecting single or multiple conductors, and of being installed with one wrench.
   a) Type: Compact, two-hole mechanical compression connectors having two clamping bolts.
      (1) Connector Body: Provide a high copper bronze or brass alloy body.
      (2) Bolts: Provide brass or bronze bolts; plated steel screws are unacceptable.
      (3) Fasteners: Provide silicon-bronze fasteners for bolting connectors to connections.

c. Crimped Compression Connectors:
   1) Provide two-hole crimped compression type connectors fabricated from high conductivity, seamless, electrolytic wrought copper, electrolytically tin-plated, and color coded to match the dies.
   2) Provide crimped compression type connectors with adequate area to conduct the electrical current.
   3) To crimp connectors, provide crimping tools from the same manufacturer that manufactured the connectors.

3. Control Wiring Connections:
   a. For control wiring connections at terminal boards, provide crimped nylon- insulated ring terminals.
   b. For control wiring splices, provide nylon insulated butt splices with insulation grips.
   c. For joining more than two control wires, provide junction boxes with terminal boards.
4. Instrumentation Cable Connectors:
   a. For connecting instrumentation cable and the equipment being furnished under this Contract, provide companion type connectors.
      1) For equipment controllers/enclosures that are furnished under other Sections of this Contract, furnish the connectors for connecting cable to the equipment with the equipment.
      2) Terminate the wiring as required for proper operation.
   b. Manufacturers:
      1) Thomas & Betts Corp.
      2) AMP Inc.
      3) Ilsco Corp.
      4) Ideal Industries, Inc.
5. Connectors for Other Conductors:
   a. Any of the applicable types listed for larger wire may be provided.
   b. Screw Terminal Connections:
      1) For making terminal connections of stranded copper wire to screw terminals, provide nylon insulated crimped compression terminals with copper barrel on the wire.
      2) For making terminal connections of solid copper wire to screw terminals, provide screw lock connectors.
   c. Wire Nuts:
      1) For making splices of copper wire, provide pre-insulated, UL-listed, solderless connectors of the spring-lock or compression type that can be installed by hand or using tools.
      2) For site lighting, wire nuts used in underground or below grade locations is prohibited. There only permitted use for site lighting is within a pole base.
   d. Manufacturers:
      1) Thomas & Betts Corp.

2) Tyco Electronics, AMP Inc.
3) Ilsco Corp.
4) FCI-Burndy® Products
5) Approved equal.

2.4 SOURCE QUALITY CONTROL

A. Tests:
1. 600 Volt Rated Multi-Conductor Cable:
   a. 70,000 BTU/hr Vertical Tray Flame Test:
      1) 600 Volt rated multi-conductor cable must pass the vertical tray flame test requirements of UL 1569, IEEE 383, and IEEE 1202.
   b. 210,000 BTU/hr Vertical Tray Flame Test:
      1) 600 Volt rated multi-conductor cable must pass the vertical tray flame test requirements of ICEA T-29-520.
2. Tray Cable:
   a. 70,000 BTU/hr Vertical Tray Flame Test:
      1) Tray cable must pass the vertical tray flame test requirements of UL 1277, IEEE 383, and IEEE 1202.
   b. 210,000 BTU/hr Vertical Tray Flame Test:
      1) Tray cable must pass the vertical tray flame test requirements of ICEA T-29-520.
   c. VW-1 test:
      1) Tray cable insulated conductors must pass the VW-1 test requirements of UL 1581.
3. Shielded Instrumentation Tray Cable (2/C Cable):
   a. Vertical Tray Flame Test:
      1) Shielded instrumentation tray cable must pass the vertical tray flame test requirements of UL 1581 to obtain a VW-1 rating.
4. Shielded Instrumentation Cable (2/C Cable):
   a. Vertical Tray Flame Test:
      1) Shielded instrumentation cable must pass the vertical tray flame test requirements of UL 1685 with UL loading.
5. Armored Instrumentation Cable:
   a. 70,000 BTU/hr Vertical Tray Flame Test:
      1) Armored instrumentation cable must pass the vertical tray flame test requirements of UL 1581, IEEE 383, and IEEE 1202.
   b. 210,000 BTU/hr Vertical Tray Flame Test:
      1) Armored instrumentation cable must pass the vertical tray flame test utilizing the corner configuration.
      2) Armored instrumentation cable must pass the vertical tray flame test requirements of ICEA T-29-520.
      3) Such statements are subject to the approval of the Engineer before the product may be used for this Contract.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Install the work of this Section only under the supervision of licensed electricians.

3.2 EXAMINATION

A. Inspect all conduits, junction boxes, electrical vaults, and handholes to verify that they are clean, that they do not have burrs, that conduits are properly aligned, and that they are complete.
   1. Ensure that on all conduits without threaded hubs, two locknuts are installed.
   2. Ensure that in all conduits with wires larger than No. 10, bushings are installed.
   3. Ensure that grounding bushings and fittings are installed at all places specified in Section 26 05 26, Grounding and Bonding.
   4. Verify that proper sized boxes are installed.

B. Verify that boxes and conduit fittings conform to the bending requirements specified in Article 314 of NFPA 70 (NEC).

3.3 PREPARATION

A. Verify that pulling calculations have been made and are available for long conduit runs and pulls as indicated in this Section.

B. Do not begin installing wiring until other work which might cause damage to the wires, cables, or conduits has been completed.
   1. Correct deficiencies in conduits, junction boxes, electrical vaults, and handholes that have been discovered by the inspection required in Paragraph 3.02.A.

C. Prepare conduits to receive wire and cable.
   1. Swab the conduits with a nylon brush and steel mandrel.
   2. Pre-lubricate the conduits for which the pulling tension calculations are based on a coefficient of friction less than that of a dry conduit.

D. Verify that a means of controlling the pulling tension on the wire or cable is installed on the mechanical assist devices furnished for pulling cable.

E. Take the necessary precautions to prevent water, dirt, or other foreign material from accumulating in the conduits during the execution of wiring work.

3.4 INSTALLATION

A. Low Voltage Ground, Power, and Control Wiring:
   1. Install Type CL2P, FPLP, or CMP cable as required by the application in accordance with the requirements of NFPA 70 (NEC).
      a. For exposed low voltage wiring, use plenum cable.
      b. For low voltage wiring concealed from view, only install wiring in the accessible locations permitted by the Contract Drawings.

2. Neutral Conductors:
    a. For each single-phase and each multi-phase feeder, provide separate neutrals.
    b. For branch circuits, except at three-phase wye-connected panelboards, provide separate neutral conductors.
        1) For the three-phase wye-connected panelboards, provide common neutrals from 3 adjacent single-pole circuit breakers or from the poles of the same multi-pole circuit breaker.
    c. Except for feeders with a small unbalanced and single-phase load, size each neutral the same as the largest phase conductor.
        1) For feeders with a small unbalanced and single-phase load, size the feeders to the largest of the following:
            a) The size of any three-phase load connected to the neutral, which contains lighting, computer power outlets, instrumentation, or other electric loads.
            b) The size required for 125 percent of the maximum unbalanced load.
3. Equipment Ground Conductors:
    a. Provide a green equipment ground conductor with all runs.
        1) Provide the equipment ground conductor wire type as specified in Section 26 05 26, Grounding and Bonding.

B. Special Cable Installation Requirements:
1. In addition to the other installation requirements specified within this Section, comply with the manufacturer's installation instructions for bending, pulling, connector types, and grounding when installing armored variable frequency drive cable.
    a. Submit the manufacturer's installation instructions for armored variable frequency drive cable.

C. Pulling Cable:
1. Establish a feed-in point at the manhole, handhole, or building located at the highest elevation of the run, and pull cables down grade using flexible cable feeds to convey the cables into the duct runs through the feed-in point opening.
    a. Furnish quadrant blocks located properly along the cable run.
    b. Limit cable pulling tensions to the maximum pulling tensions recommended by the cable manufacturer.
        1) Measure the cable pulling tension on all runs pulled with mechanical assistance and for all cable runs where calculations are required to be submitted by using a dynameter.
        2) Remove cables subjected to excessive bending and tension and that are cracked or have damaged or nicked outer jackets from the Site, and replace these cables with new undamaged cables.
            a) If pulling tension is exceeding during pulling, remove the affected cables and mark them as not to be reused.
    c. Lubricate cables with lubricants during pulling.

D. Installing Cables in Manholes:
1. Install cable along the manhole wall that provides the longest route and the maximum spare cable length.
2. Form cables so they closely parallel the walls, and do not interfere with duct entrances.
3. Support cable on brackets and insulators spaced at a maximum of 2 feet apart.
4. Use pulling lubricants approved by the cable manufacturer.

E. Terminating Cable:

1. Terminate cable using materials and methods indicated or specified herein, or in accordance with the written instructions of the cable manufacturer or termination kit manufacturer.
   a. For equipment connections, provide split bolt or compression type connectors, mechanical compression connectors, or crimped compression type connectors as specified and approved by the equipment manufacturer; for all other types of connections provide connectors of one of the types specified:
2. Protect insulated power and lighting cable terminations from accidental contact, deterioration of coverings, and moisture by using proper terminating devices and materials.

F. Splicing Wire and Cable:
   1. Install all service and feeder conductors from end to end without splices.
   2. Install all motor conductors from the starter to the motor without splices.
   3. Only splice cables in accessible locations.
   4. Below-Grade Splices:
      a. In underground systems, locate splices above the 100 year flood level.
      b. Make below-grade splices using a compression connector on the conductor.
      c. Insulate and waterproof below-grade splices by methods suitable for continuous submersion in water using either of the methods that follow:
         1) Gravity Pour Method:
            a) Provide an approved commercial waterproof splice kit with the necessary materials and equipment, including a mold suitable for the cables to be spliced.
               (1) When the mold is in place around the joined conductors, prepare and pour the resin mix into the mold.
         2) Cast-Type Splice Insulation:
            a) Provide an approved commercial waterproof splice kit with the necessary materials and equipment, including a thermosetting epoxy resin insulating material applied by a gravity pour method or by a pressure injection method.
            b) Fix cables in place until the splicing materials have completely set.
      d. Within outlet or junction boxes, make wire and cable splices that conform to the requirements of NFPA 70 (NEC).
      e. Install these outlet or junction boxes in accessible locations.

G. Wiring Identification:
   1. Color code all feeder wires and cables as indicated in Table **26 05 19**-1, Table 26 05 19-2 and/or Table 26 05 19-3.

Table 26 05 19-1 Feeder Wire and Cable Color Coding

Phase	480Y/277 Volts	208Y/120 Volts
A	Brown	Black
B	Orange	Red
C	Yellow	Blue
Neutral	Gray or White with Yellow Tracer	White
Electrical Ground Conductor	Green	Green

Table 26 05 19-2 Feeder Wire and Cable Color Coding	
Phase	**120/240 Volts Single-Phase**
A	Black
B	Red
Neutral	White
Electrical Ground Conductor	Green

Table 26 05 19-3 Feeder Wire and Cable Color Coding	
Phase	**240/120 Volts Three-Phase High Leg**
A	Black
B	Red
C	Blue
Neutral	White
Electrical Ground Conductor	Green
High Leg	Add Orange tape to color indicated above

2. Identify all power wiring by circuit and panelboard, switchboard, and motor control center numbers.
3. Identify all control wiring with wire numbers.
4. Provide additional electrical identification of cabling and wiring as specified in Section 26 05 53, Electrical Identification.

3.5 FIELD QUALITY CONTROL

A. Site Tests:
   1. Prior to energizing wire and cable, field test the wire and cable as specified in Section 26 05 63, Electrical Testing.

B. Inspection:
   1. Record the actual installed elevations and locations of grounding cables and rods, both concealed and exposed, on the record drawings specified in Section 17 80 00, Closeout Submittals.
      a. Verify that the control wiring wire numbers correspond to the numbers indicated in the record drawings.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for connecting, energizing, testing, cleaning, and protecting grounding and bonding systems.

B. Related Sections:
   1. Section 01 33 00 – Submittal Procedures.
   2. Section 26 05 00 – Common Work Results for Electrical
   3. Section 26 05 63 – Acceptance Testing for Electrical Systems.
   4. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables
   5. Section 26 05 33.13 – Conduit for Electrical Systems

1.2 REFERENCES

A. American Public Works Association (APWA):
   1. APWA Public Works Management Practices Manual.

B. American Society for Testing Materials (ASTM):
   1. ASTM B 1; Standard Specification for Hard-Drawn Copper Wire.
   2. ASTM B 3; Standard Specification for Soft-Drawn Copper Wire.
   3. ASTM B 8; Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   4. ASTM C 653; Standard Guide for Determination of the Thermal Resistance of Low-Density Blanket-Type Mineral Fiber Insulation.
   5. ASTM D 5; Standard Test Method for Penetration of Bituminous Materials.
   6. ASTM D 149; Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
   7. ASTM D 257; Standard Test Methods for D-C Resistance or Conductance of Insulating Materials.
   8. ASTM D 570; Standard Test Method for Water Absorption of Plastics.

C. InterNational Electrical Testing Association, Inc. (NETA):
   1. ANSI/NETA ETT Standard for Certification of Electrical Testing Technicians.

D. National Fire Protection Association (NFPA):
   1. NFPA 70, National Electrical Code (NEC).

E. National Electrical Manufacturing Association (NEMA):
   1. NEMA TC-2; Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
   2. NEMA TC-3; Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
   3. NEMA TC-14; Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

4. NEMA WC-7; Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

F. Underwriter's Laboratories, Inc. (UL):
1. UL 467, Standard for Grounding and Bonding Equipment.
2. UL 486A-486B, Wire Connectors.
3. UL 486C, Standard for Splicing Wire Connections.
4. UL 486D, Standard for Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.
5. UL 486E, Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.

1.3 DESIGN REQUIREMENTS

A. Design the electrical system installation to conform to Article 300 of NFPA 70, Wiring Methods, and to other applicable articles of NFPA 70 governing methods of wiring.

B. Ground the conduit systems, metal enclosures, equipment frames, motors, and receptacles in accordance with Article 250 of NFPA 70, Grounding.
1. Ground all metallic conduits, wiring channels, and armored cables continuously from outlet to outlet, and from outlets to cabinets, junction boxes, or pull boxes.
   a. Bond each run of raceways to form a continuous path for ground faults from end to end.
   b. When liquid tight flexible metal conduit sizes larger than 1-inch or flexible metal conduit are installed, provide external bond wires.
2. Grounding Bushings:
   a. Provide all 1-inch or larger metallic conduits with grounding bushings unless they enter metallic enclosures via integral threaded hubs.
   b. Provide grounding bushings for conduits entering the bottom of freestanding equipment.
   c. Bond wire from every grounding bushing to the equipment ground stud or ground bus in the enclosure.
   d. Bond the grounding bushings to ground studs or ground buses in the enclosures.
3. Provide insulated, internal equipment ground wire in all conduits.
   a. Bond the internal wire to all pullboxes, junction boxes, equipment enclosures, and other enclosures as required by NFPA 70.

C. Equipment Grounds:
1. Design all feeders and branch circuits to include an equipment grounding conductor consisting of a copper wire within a raceway or cable and sized as specified herein.
   a. Where conductors are run in parallel in multiple raceways, run the equipment grounding conductor in parallel to the related conductors.
   b. Size each of the parallel equipment grounding conductors on the basis of the ampere rating of the circuit overcurrent protecting device.
2. Ground enclosing cases, mounting frames, rack mounted components, rack struts, switches, breakers, control panels, motors, and other electrical or electrically operated equipment by providing an equipment grounding conductor with phase conductors from an established equipment ground source.

D. Ground Wire Sizes:

1. The minimum size for bonding jumpers, equipment ground conductors, grounding electrode conductors, and ground grid conductors is as follows:
    a. Under 600 volts:
        1) Provide #12 AWG, minimum.
        2) Control power circuits, Provide #14 AWG, minimum.
    b. Over 600 volts:
        1) For transformers, provide #2 AWG ground wire, minimum.
        2) For motors, provide #4 AWG ground wire, minimum.
2. When the ground wire size is not specified or indicated on the Contract Drawings, provide wire sized in accordance with the requirements of NFPA 70.

E. Within 60 days of the Contract award, submit the following:
1. The Submittals required by Section 26 05 00.
    a. Include Product Data and Catalog Cuts for all products provided and describe the usage of each product.
2. Shop Drawings for the ground well grid installation in unpaved areas.
3. Shop Drawings for the ground well grid installation in paved areas.
4. Shop Drawings for the ground bus installation.

F. Project Record Documents:
1. Prepare and submit record drawings showing the actual installed elevations and locations of grounding cables and rods for both concealed and exposed work provided under this Contract.

G. Project Closeout:
1. Submit Operation and Maintenance Manuals that include the record drawings and all Product Data in accordance with Metro North standards.

1.4 SUBMITTALS

A. Submit the following information for approval in accordance with the requirements of Section 01 33 00, Submittal Procedures:
1. Product Data:
    a. Manufacturer’s product data
2. Shop Drawings:
    a. Ground well grid installation in unpaved areas.
    b. Ground well grid installation in paved areas.
    c. Ground bus installation.
3. Quality Assurance/Quality Control Submittals:
    a. Certificates:
        1) Testing agency product certification
    b. Qualification Statements:
        1) System installers’ qualifications
        2) Installation supervisors’ resumes
4. Closeout Submittals:
    a. Operation and Maintenance Manuals

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installer Qualifications:
   a. Employ installers who specialize in the work of this Section, and who can demonstrate a minimum of three years documented experience.
   b. Submit the system installers' qualifications.
2. Supervisor's Qualifications:
   a. Employ supervisor to supervise the installation work who are skilled licensed electricians.
   b. Submit the installation supervisors' resumes.
3. All products are to be certified by Underwriters Laboratories, Inc. (UL),

B. Regulatory Requirements:
1. All grounding and bonding Work must comply with the requirements of NFPA 70, the National Electrical Code.

C. Certifications:
1. Testing Agency Product Certification:
   a. Verify product quality by certifying products as meeting the requirements of one of the following:
      1) Underwriters Laboratories, Inc. (UL).
         a) Provide products listed and labeled by UL.
   b. Testing agency product certification must include agency listing and labeling, either by a printed mark on the data or by a separate listing card.
      1) If an item does not have this quality assurance verification, provide a written statement from the product manufacturer indicating why not; such manufacturer's statements are subject to the approval of the Owner and the Engineer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
1. Transport materials, both on site and from Contractor's storage to site, in accordance with the recommendations of the respective manufacturers.

B. Storage and Protection:
1. Store materials, both on and off site, in accordance with manufacturer's written instructions.
2. Store products indoors on blocking or pallets.

PART 2 - PRODUCTS

2.1 UNDERGROUND WARNING TAPE

A. Metal detectable polyester material, with minimum one-inch high lettering. Overcoated graphics to read, "CAUTION-BURIED ELECTRIC LINE BELOW" for electric lines and/or "CAUTION – TELECOMMUNICATION BELOW" for telephone lines. APWA color to be red for electric lines and orange for telecommunication or fiber-optic lines.

B. Acceptable Manufacturers:
1. Brady #91600 Series
2. Presco

3. Seton
4. Or Approved Equal

2.2 MATERIALS

A. Conduit and Conduit Fittings:
   1. For conduit and conduit fittings that enclose single ground wires without accompanying circuit conductors provide one of the following:
      a. Schedule 80, non-metallic conduit and fittings conforming to the requirements of Section 26 05 33.13 and the conduit additionally conforming to the requirements of NEMA TC-2, and the fittings additionally conforming to the requirements of NEMA TC-3.
      b. Fiberglass reinforced plastic (FRP) conduit and fittings conforming to the requirements of NEMA TC-14 and Section 26 05 33.13.
   2. For other conduit and conduit fittings, provide conduit of the types specified or indicated and that conform to the requirements of Section 26 05 33.13.

B. Wire:
   1. Bare Ground Wire:
      a. Soft drawn copper, Class A or Class B stranded, meeting the requirements of ASTM B3 for sizes #6 or larger.
      b. Soft drawn solid copper, meeting the requirements of ASTM B3 for sizes #8 or smaller.
   2. Insulated Ground Wire:
      a. Provide insulated Class B copper stranded wire rated for 600 volts that conforms to the requirements of NEMA WC-7, and is green in color. Insulation type shall be as specified in Section 26 05 19.
   3. Acceptable Manufacturers:
      a. Continental Wire & Cable Company www.continentalwire.com
      b. SouthWire www.southwire.com
      c. General Cable www.generalcable.com
      d. Okonite Co. www.okonite.com
      e. Or Approved Equal

C. Clamps and Non-Welded Connectors:
   1. Provide bronze or brass clamps and connectors that are UL listed for use below grade.
      a. All bolts and other material must be bronze or brass, plated steel screws are unacceptable.
      b. Fabricate multi-bolt, solderless compression clamps from high strength electrical bronze, and provide silicon bronze clamping bolts and hardware.
   2. Provide bolts, nuts, lock-washers, and similar hardware designed not to damage ground wire.
   3. Acceptable manufacturers:
      a. Ilsco.
      b. Framatone Connectors Inc. (FCI), Burndy.
      c. Or Approved Equal.

D. Exothermic Welding Kits:
   1. Provide molds, thermite packages, and other material for exothermic welds that are rated to carry 100 percent of the cable ratings, and which are letter-coded exothermic welded type.
   2. Provide all items such as tees, crosses, splices, and cable connections necessary for connecting ground and bonding cables to the following items:

a. Ground rods.
b. Reinforcing steel bars.
c. Ground-bus.
d. Structural steel.
e. Water pipe.
f. Bonding to the main-ground-grid.
g. Bonding to Copper Grounding Bus Bar

3. Provide all exothermic welding molds, thermite packages, and other material used throughout the Work from a single manufacturer.
4. Acceptable Manufacturers:
   a. Erico, Cadweld®.
   b. Continental Industries, Inc., Thermoweld®.
   c. Or Approved Equal.

E. Ground Rods:
1. Provide UL listed, sectional ground rods fabricated using a electrolytic plating process to copper clad a medium carbon steel core
2. Diameter: 3/4 inch.
3. Length: 10 feet.
   a. To obtain longer length rods, join rod sections using copper clad rod couplers.
4. Acceptable Manufacturers:
   a. Erico International Corp.
   b. Galvan Industries, Inc.
   c. South Atlantic, LLC
   d. A.B. Chance Co.
   e. Or Approved Equal

F. Concrete Protective Boxes (Ground Wells):
1. Provide precast concrete boxes with flush cast iron covers rated for heavy traffic H20 areas and having slots for conduit entrances.
   a. Minimum size: 10” diameter by 12” high with maximum depth up to 36”.
   b. Cover legend: Provide the cast-in legend “GROUND TEST WELL” in the cast iron covers provided.
2. Acceptable Manufacturers:
   a. National Lightning Protection Corporation
   b. East Coast Lightning Equipment
   c. Or Approved Equal

G. Coating Compound:
1. Provide permanently pliable, moldable, un-backed, black rubber based coating materials for covering or coating grounding clamps and connectors.
2. Coating Physical Properties:
   a. Solids/Density: 100 percent; 12 pounds per gallon.
   b. Penetration: Within 90 to130 when tested in accordance with ASTM D 5.
   c. Water Absorption: 0.10 percent, maximum, when tested in accordance with ASTM D 570.
   d. Dielectric Strength: 500 volts/mil when tested in accordance with ASTM D 149.
   e. Volume Resistivity: 2,000 megohm-inches, or 5,000 megohms-cm, when tested in accordance with ASTM D 257.

f. Service Temperature: Minus 40 degrees to 160 degrees Fahrenheit; and having no melting point; flammability, or slow burning when tested in accordance with ASTM C 653.
g. Chemical Resistance:
1) Resistant to alcohol, water, aqueous hydrochloride, and sodium hydroxide.
2) Dissolved by carbon tetrachloride, naphtha gasoline, mineral spirits, and benzene.
h. Cohesive/Adhesive: Adheres to metals, concrete, and itself.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions:
1. The Contract Drawings are generally indicative of the Work, but due to their small scale, it is not possible to indicate some offsets and fittings required nor the minor structural obstructions that may be encountered.
a. Perform field measurements to discover offsets and fitting requirements not shown.
b. Locate all on-site utilities and other obstructions in the area of construction, and verify that interferences will not occur.

3.2 PREPARATION

A. Layout electrical work to suit actual field conditions and in accordance with accepted standard practice.

3.3 INSTALLATION

A. Perform required earthwork including excavation, backfill, and compaction, as specified.

B. Construct each ground system and connection so it is mechanically secure and electrically continuous.
1. Secure grounds to boxes in such a manner that each system is electrically continuous from the point of service to each outlet.
2. Terminate conduits using double locknuts and bushings.
a. Unless a conduit run enters a metallic enclosure via integral threaded hubs, provide the conduit run with two locknuts.
3. Clean paint, grease and such other insulating materials from the contact points of grounds.

C. Ground Grids:
1. Installing Ground Rods:
a. Drive ground rods head to 6 inches below grade by using a ground rod cap to protect the head of the rod.
1) If the top of the rod is damaged during driving operations, cut it off.
2. Installing Ground Wells:
a. Install a concrete protective box for the ground well flush with the grade and 4 inches above the top of the ground rod designated on the Contract Drawings.
3. Installing Ground Wires:

a. Excavate the trenches for the ground grid cables, and lay the ground cable in the trenches from ground rod to ground rod without splice, and from one side of the grid to the other as shown on the Contract Drawings.
   1) Lay the ground grid cables cable allowing 10 percent slack.
   2) Form 12-inch minimum radius bends at changes in direction.
   3) At intersections, place cables so they diverge 60 degrees or more from other cables at the intersection.
   4) Connect service entrance grounds directly to the ground grids without splices in the cable.

b. Route connecting cables from the ground grid in the trenches to the building structure.
   1) Route exposed cables parallel to the building lines, except for bends; form all bends with a 12-inch minimum radius.
   2) Wherever the cable breaks grade, provide schedule 80 conduit from 2- feet below finished grade to 3-feet above finished grade for protection; and provide conduit at other points where the cable may be subject to damage.

c. Clamp the conduit to the building structure's wall at the ends and at intervals not to exceed 5 feet.
   1) Whenever cable exits from the conduit, clamp the cable to the wall at intervals not to exceed 5 feet and at each entrance to equipment.
   2) Allow a 1/4 inch space between ground cables, conduit, and the surface it is mounted on.

d. Remove any damaged or kinked cable.

4. Welding ground wires to the ground rods and equipment connections.
   a. Follow the procedures of the exothermic welding kits manufacturer.
   b. Prior to welding ground wires to the ground rods and equipment connections perform the following:
      1) Clean the proposed welding area of combustible and flammable materials; and block access to personnel to protect them from harm; and provide a shield to prevent damage to other materials.
      2) Clean insulation from ground wire for a distance of 12 inches, and clean the exposed wire to a bright finish.
      3) Clean paint, grease, and other similar insulating materials from contact points.
      4) Inspect the molds for damage; and discard any faulty mold or any molds used over 40 times.
   c. Exothermically weld the ground wires to the ground rods as shown on the Contract Drawings, including to ground rods at grid crossings, to ground rods at grid intersections on the sides of the ground grid, and at all equipment connections.
   d. After completing the welding, replace the insulation removed from insulated wires, and coat connections and the area around connections with coating compound.
      1) Coating Thickness: 1/8-inch, minimum.
      2) Make sure the coating is free from pin-holes and holidays.

5. Make all connections to electrical equipment and ground buses with compression, two-hole lugs and studs.
   a. Clean paint, grease, and other similar insulating materials from the contact points for the ground lugs and studs.
   b. Clean all wires to a bright finish prior to construction the connections.

D. Equipment Ground Buses:
   1. Whenever several pieces of equipment, other than service grounds, require external bond wires in an area, provide an equipment ground bus.
   2. Wherever 5 or more conduits enter a box or enclosure, provide an equipment ground bus.

a. Connect all equipment ground wires and conduit bond wires within the box or enclosure to a single ground stud or single common ground bus.

3. Size ground buses to carry 100 percent of the rating or setting of the largest over current device in the circuit(s) ahead of the equipment, conduit, or other item, and as indicated on the Contract Drawings.

E. Equipment Grounds:

1. Install equipment grounds in spaces accessible to authorized personnel only.
2. Equipment Grounding Connectors:
   a. Only use approved grounding connectors.
      1) Terminate grounds with closed lugs with star washers on both sides and a 1/4-20 bolt and nut, minimum; spade lugs are not allowed.
      2) For portable electrical equipment, provide electric cords having an equipment grounding conductor and a NEMA and UL approved cord cap.
   b. Do not install grounding lugs on flanges, mounting screws, or standoffs in switches, distribution boxes, or panels.
   c. Cover or coat grounding clamps and connectors with coating compound.
3. Equipment Grounding Conductors:
   a. Unless using multi-conductor cable, run equipment grounding conductors inside the same conduit or wiring channel enclosing the power conductors.
   b. In multi-conductor cable, locate grounding conductor inside the sheath or cable.
   c. Do not use a system neutral or a current carrying conductor as the equipment grounding conductor.
      1) Do not ground the electrical and electronic equipment neutral to chassis, racks, equipment ground conductor, or any non-current carrying conductor on the equipment.
4. Grounding Lighting Fixtures:
   a. Provide the housing of each lighting fixture with a separate, factory-installed grounding device and ground conductor.
   b. Use the factory-installed grounding device for connecting a separate grounding conductor meeting applicable grounding requirements of the NEC to the fixture.
      1) Provide a green covered grounding conductor of the same wire gauge as the two power feed wires.
      2) Provide a continuous ground for the fixture construction.
5. Grounding Motors:
   a. Install equipment grounding wire within conduit supplying power to motor.
   b. Install bonding connectors across the liquid tight flexible conduit supplying motors.
6. Grounding and Bonding Pumps:
   a. Provide a bond from each pump to its motor using a conductor equal in size to the motor circuit equipment grounding conductors.
7. Grounding Transformers:
   a. If a transformer is a separately derived system as defined in NFPA 70, provide a ground wire in both the primary and secondary conduits; and bond the ground wire and metallic conduits, if used, to the nearest effectively grounded metallic water pipe or nearest effectively grounded structural steel column.
   b. Provide an additional bond between cold or hot water pipes and structural steel located near a transformer bond connection.
8. Grounding Isolated Ground Receptacles:
   a. Ground the receptacle grounding terminal via an insulated equipment grounding conductor routed with the circuit conductors within the raceway.

1) This grounding conductor may pass through one or more panelboards without being connected to the panelboard grounding terminal in order to terminate directly at an equipment grounding conductor terminal of the applicable separately derived system or service within the same building or structure.

b. Use of isolated equipment grounding conductors does not remove the requirement for grounding the raceway system and outlet box.

9. Fences:

a. Fences shall be bonded to dedicated ground rods in at least two locations in and at a maximum interval of 200 feet around fences longer than 400feet. Ground rods shall be equally spaced around the perimeter of the fence.

b. Fences shall be bonded to dedicated ground rods at each side of a gate or other opening.

1) A buried bonding jumper shall be used to bond across a gate or other opening.

c. Gates and any barbed wire strands shall be bonded to the grounding conductor, jumper or fence.

d. When fence posts are of conducting material, a grounding conductor shall be bonded to the fence post as required with a suitable connecting means. For non-conducting posts, suitable bonding connection shall be made to the fence mesh and barbed wire strands at each grounding conductor point.

e. For fences located within 5 feet of electrical equipment (transformers, switchgear, etc.), each fence ground rods shall be bonded to the equipment ground bus.

f. For outdoor substations where a station ground ring and/or mat is installed, each fence ground rod shall be bonded to the station ring and/or mat.

g. Where an overhead power line crosses a fence, the fence shall be bonded to at least one additional dedicated ground rod installed directly under the line. This ground rod shall be bonded to the nearest pole ground.

h. Bonding conductors shall be minimum 6 AWG copper unless otherwise indicated on the plans.

i. Ground rods, bonding jumpers, and connections shall comply with Section 26 05 26.

3.4 REPAIR/RESTORATION

A. Replace any finished exothermic welded splice connections that inspections find to be defective.

B. After inspection by Engineer and Owner's representative, backfill the direct buried cables and around ground rod protectors.

1. Begin backfilling with clean washed sand to 6 inches above the ground rods or to the depth shown on the Contract Drawings, whichever is greater.
2. Backfill using select fill in accordance with the requirements of Section 02315.
3. Slope the finish grade away from ground rods at a slope of 1 inch in 18 inches for a distance of 27 inches from the rods in all directions.

C. Install underground warning tape above all buried cables/conduits at a depth of 12" below finished grade.

3.5 FIELD QUALITY CONTROL

A. Site Testing:

1. Prior to energizing any system, test the resistance to ground for the system in accordance with Section 26 05 63.

a. Perform a continuity test from all utilization and distribution equipment to the ground grid on a run-by-run basis.

B. Inspection:
1. Prior to completion of the Work of this Section, inspect the items provided for conformity to the Contract Drawings and Specifications.
   a. Leave in-place "made grounds" open until they have been inspected and approved by the Engineer.
   b. Clean the surfaces involved in "made grounds" before connecting the grounds, and finish the installation with touch up painting or another protective coating to prevent corrosion.
2. Inspect finished exothermic welded connections for the following defects:
   a. Conductors appear within the splice area.
   b. Top of splice risers are below conductors.
   c. Surfaces exhibiting more than 20 percent slag material.
   d. Surfaces with over slag material that has flowed into conductors.
   e. Mold blowouts.
   f. Excessive porosity.
      1) Small pores less than 1/32 inch are permitted.

3.6 PROTECTION

A. Protect finished insulated wires from being painted.

B. Protect all ground grid wells from damage during paving and landscaping.

C. Protect all ground grid installations and ground wires from damage during the work of other Sections.

END OF SECTION

SECTION 26 05 48 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This dual-purpose section provides for vibration isolation as well as seismic control for the "equipment" as listed below. This specification is part of the general conditions for the Electrical contract.

1.2 REFERENCES

A. International Building Code (IBC)
   1. IBC 2012

1.3 DESCRIPTION

A. Intent:
   1. All equipment listed below and conduit shall be seismically braced. Vibration control shall apply as described herein.
   2. Seismic bracing and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
   3. It is the intent of the seismic portion of this specification to keep all electrical building system components in place during a seismic event and operational.
   4. All such systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.
   5. This specification is considered to be minimum requirements for seismic consideration.
   6. Any variance or non-compliance with these specification requirements shall be corrected by the Contractor in an approved manner.

B. The work in this section includes, but is not limited to the following:
   1. Vibration isolation for equipment.
   2. Seismic restraints.
   3. Certification of seismic restraint designs and installation supervision.
   4. Certification of seismic attachment of housekeeping pads.
   5. All equipment, (components) requiring IBC certification.
   6. All inspection and test procedures for equipment, (components) requiring IBC certification.
   7. All electrical equipment and systems within or on the building. Equipment buried underground is excluded but entry of services through the foundation wall is included. Equipment referred to below is typical. (Equipment not listed is still included in this specification).
   8. For IBC projects, all systems listed in or part of this paragraph are referred to as components.

Battery Chargers	Light Fixtures
Battery Racks	Motor Control Centers
Bus Ducts	Supports
Cable Trays	Switchboards

Conduit
Electrical Panels
Equipment Supports
Generators
Transformers
Variable Frequency Controllers

C. Definitions (all codes):
1. Life Safety Systems:
a. All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems.
b. All mechanical, electrical, plumbing or fire protection systems that support the operation of or are connected to emergency power equipment including all lighting, generators, transfer switches and transformers.
c. Automated supply, exhaust, fresh air and relief air systems on emergency control sequence including air handlers, duct, dampers, etc.
2. Positive Attachment:
a. Positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double-sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, duct work, fire protection or any other equipment are not acceptable on this project as seismic bracing points.
3. Transverse Bracing:
a. Restraint(s) applied to limit motion perpendicular to the centerline of the pipe or duct.
4. Longitudinal Bracing:
a. Restraint(s) applied to limit motion parallel to the centerline of the pipe or duct.
5. Refer to Chapter 16 of the IBC 2009 for additional definitions.

1.4 QUALITY ASSURANCE

A. Substitution of internally or externally isolated and restrained equipment supplied by the equipment vendor, 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 from their Engineering Department P.E. stamped and certified per the section on Seismic Restraint Design (paragraph 1.05) stating that the seismic restraints are in full compliance with these specifications.

B. Letters from field offices or representatives are unacceptable. All costs for converting to the specified vibration isolation and/or restraints shall be borne by the equipment vendor in the even of non-compliance with the preceding.

C. Letters from representatives are unacceptable.

1.5 SUBMITTAL DATA REQUIREMENTS

A. Refer to Section 26 05 00.

B. The manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:
1. Descriptive Data:

a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.

2. Shop Drawings:
   a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
   b. Provide all details of suspension and support for ceiling hung equipment.
   c. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details or acceptable attachment methods for ducts and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
   d. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
3. Seismic Certification and Analysis:
   a. Calculations by the Manufacturer's qualified licensed Engineer substantiating the mounting system, seismic restraints and recommended anchor bolts shall e submitted for approval along with the shop drawings. Calculations shall be based on the loads as established in the table at the end of this section. All analysis shall be stamped by a registered professional having a P.E. from the same state as the project.
   b. Unless otherwise specified, all equipment and conduit shall be restrained to resist seismic forces. Restraints shall maintain equipment or conduit in a captive position. Restraint devices shall be designed and selected to meet seismic requirements as defined in the latest issue of:
      1) Applicable state and local codes
      2) IBC International Building Code
4. International Building Code Additions: In addition to all of the above provisions, Contractor shall comply with sections 16 and 17 of the International Building Code using only vendors that comply with the provisions stated herein and submitting the special inspections listed within these specifications. Where compliance is not possible, each Contractor shall submit a vendor report clearly indicating that none of the specified, listed or other vendors known to the Contractors meet the compliance, testing and certification portions of the IBC spec section 16 and 17. Special inspections shall still be conducted even if no vendors meet the enclosed requirements. All non-isolated and isolated equipment, (components) shall be secured to the structure in accordance with that code.
   a. All component manufacturers shall submit for approval the following as required below:
      1) All life safety system components noted in this specification will have the manufacturer of that component submit the Approved Agencies Certificate of Compliance for the specific equipment on this project when the Seismic Design Category is "C – F". Analytical or shaker test certification thru the component's load path including structure at its center of gravity shall include anchorage, structural and online capability.
      2) All components noted in this specification will have the manufacturer of that component submit the Approved Agencies Certificate of Compliance for their equipment when used on a Seismic Design Category is "C-F". This requirement also pertains to projects that combine an emergency preparedness center within a structure of another Occupancy Category where that component is needed for continued operation of the building or whose failure could impair the continued operation of the building. Note: the definition of the above refers to any

component which does not allow or hampers the use or capability of the intended purpose of that structure Analytical or shaker test certification thru the total component's load path to structure at its center of gravity shall include anchorage, structural and on line capability.

3) All components containing hazardous or flammable materials will have the manufacturer of that component submit the Approved Agencies Certificate of Compliance for their equipment when used on any project having a minimum Seismic Design Category of "C-F". Analytical or Shaker Test Certification thru the total component's load path to structure at its center of gravity shall include anchorage and structural capability to insure against loss of hazardous or flammable, (explosive) material.

4) All components that are not listed in the above categories shall have the manufacturers of each component submit a PE stamped calculation package that their project specific equipment will accept anchorage through the component's load path to structure at its center of gravity at the designated anchorage locations. This requirement is for all projects having a Seismic Design Category of (C-F).

b. The following systems shall require Special Inspection and Periodic Special Inspection for anchorage during the course of construction as defined earlier in this section for all buildings in Seismic Design Categories C-F.

1) All electrical components for standby or emergency power systems require Periodic Special inspection.
2) All flammable, combustible and highly toxic piping and their associated mechanical systems.
3) All equipment using combustible or toxic energy sources.
4) All electric motors, transformers, switchgear unit substations and motor control centers.
5) Reciprocating and rotting type machinery.
6) Conduit, 3" and larger.
7) Isolator units for seismic isolation system.

C. Contractor Responsibilities and Approvals:

1. Each Contractor responsible for the installation of the components above shall be responsible for submitting to the design team for their approval a written Contractor's statement of responsibility as outlined below.
   a. Identify the components that are part of the Quality Assurance Plan.
   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.

D. Design Loads:

1. Projects will have a maximum design load of .4g for statically mounted components and .9g for resiliently mounted components.
2. The minimum horizontal restraint capability shall be 0.4 g horizontal and .27 vertical. Life safety equipment defined above shall be designed to survive a horizontal load of .9g and a vertical load of .6g.
3. Testing or calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered Professional Engineer with at least five years of seismic design experience and licensed in the state of the job location. Testing

and calculations must include shear and tensile loads as well as one test or analysis at 45° to the weakest mode. IBC Component testing must be by an Approved Agency.

4. Analysis for anchorage must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in Section 4 acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.
5. Vertical load shall be calculated at 2/3 the horizontal load.
6. Internally isolated equipment in lieu of specified isolation and restraint systems must meet the specified isolation and system restraint criteria.
7. A seismic design Errors and Omissions insurance certificate MUST accompany the equipment manufacturer's certification. Product liability insurance certificates are not acceptable.
8. In the event that the equipment is internally isolated and restrained, the entire unit assembly must be seismically attached to the structure. Curb or roof rail mounted equipment must not only have seismic attachment of the equipment to the roof but also to the curb or rails. The attachment and certification thereof shall be by this section.

1.6 RELATED WORK

A. Housekeeping pad design shall be as indicated on the drawings. Attachment shall be designed and certified according to this section by the seismic/isolation supplier. Material and labor required for attachment and construction shall be by the Contractor. Housekeeping pads shall be sized to accommodate a minimum of six (6) inches of clearance all around the equipment or 12 times the anchor bolt diameter, whichever is greater and its mounting package. Structural support and connections for all equipment, including roof-mounted equipment, specified in other sections shall comply with all IBC requirements indicating load path to the structure. .

B. Lay-in ceilings in compliance with seismic zone requirements may use earthquake clips or other approved means of positive attachment to brace fixtures such as lights and diffusers less than 75 pounds to T-bar structures. Local codes dictate support requirements.

1.7 CODE AND STANDARDS REQUIREMENTS

A. Applicable Codes and Standards:
   1. All City, State and Local Codes.
   2. American Society For Testing and Materials (ASTM) Standard.
   3. International Building Code (IBC).

B. In cases where requirements vary, the guideline for the most stringent shall be utilized.

C. Use IBC-2009 as reference code standard unless otherwise designated.

1.8 MANUFACTURER'S RESPONSIBILITY

A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:
   1. Determine vibration isolation and seismic restraint sizes and locations.

2. Provide vibration isolation and seismic restraints as scheduled or specified.
3. Provide calculations and materials if required for restraint of unisolated equipment.
4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.
5. Certify correctness of installation upon completion.
6. All provisions of section 1.05.B.3. Seismic Certification & Analysis.

B. All manufacturers providing equipment and/or vibration/seismic control systems must provide a Seismic Design Error and Omissions Insurance Certificate for their firm or their design consultant to certify their ability to provide engineering and design as required by this Section.

C. All manufacturers' including Original Equipment Manufacturers (OEM) are responsible for Section 1.01 through 1.06, including 1.05.B.3. Seismic Certification & Analysis.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. All vibration isolation and seismic devices described in this section shall be the product of a single manufacturer.

B. Design of hardware and devices such as beam clamps, anchor bolts, cable and cast- in-place plates must be by this section's supplier to ensure seismic compliance and certification. The Contractor has the option to utilize alternate fastening devices (anchor bolts) so long as the sizing and dimensions on seismic submittals are followed.

C. Unless otherwise specified, all isolator hardware shall be zinc plated. Springs with a deflection of up to 2 inches shall be coated with a polyester epoxy powder. Springs and rubber isolators shall be color coded for proper identification of rated load capacity. Zinc plating shall conform at ASTM B633, Class 2 SC2, minimum. All other metal parts used outdoors shall be hot spray or hot dipped galvanized.

2.2 VIBRATION ISOLATION AND SEISMIC RESTRAINT TYPES

A. Double Deflection Neoprene:
1. Double deflection neoprene mountings shall have a minimum rated static deflection of 0.40 inches. Steel top plate and base plate shall be completely bonded and embedded in oil-resistant elastomer. Mountings shall be molded in color for ease of identification of load capacity, and shall have ribbed neoprene surfaces on top and bottom to provide friction pads for those applications, which do not need to be bolted to the floor or to equipment. Bolt holes shall be provided on the bottom plate, and a tapped hole on the top, for applications requiring positive tie down.
2. Acceptable Manufacturers:
   a. Vibration Mountings and Controls, Inc.
   b. Mason Industries.
   c. Vibration Eliminator.

B. Floor Mounted Spring Isolators:

1. Free standing spring-type isolators, shall be laterally stable without housing, snubbers, or guides, and shall include a steel reinforced, ribbed neoprene cup (¼ inch minimum thickness) between the baseplate and the support. Mountings shall have leveling bolts on the top, consisting of an adjusting bolt, cap screw and washer. Mountings shall include a bolt hole in the bottom cup or a two hole rectangular steel baseplate for bolting to the structure.
2. Springs shall not be welded to the baseplate or cup. Spring diameters shall be no less than 0.8 times the compressed height of the spring at rated load. Springs shall also have a minimum additional travel to solid equal to 50% of the rated deflection.
3. Acceptable Manufacturers:
    a. Vibration Mountings and Controls, Inc.
    b. Mason Industries.
    c. Vibration Eliminator.

C. Housed Springs With Limit Stops:
1. Free standing, laterally stable spring type isolators. Isolator is the same as described in Specification 2.02.B, except that it includes a housing to provide vertical limit stops to prevent spring extension during weight changes, or when equipment is exposed to uplift loads such as wind loading. The housing serves as blocking during erection, and shall be located between the equipment and supporting structure. There shall be a minimum clearance of ¼" between the restraining bolts and the housing and spring to prevent interference with spring performance. Limit stops shall be out of contact during normal operation. Mountings shall have an adjusting bolt on the top of the spring compression plate. For non-seismic applications, neoprene acoustical non-skid pads (¼ inch minimum thickness) shall be attached to the bottom plate. When used in seismic applications, neoprene bushings shall be incorporated in the limit stop plate. Spring diameters shall be no less than 0.8 times the compressed height of the spring at rated load. Springs shall also have a minimum additional travel to solid equal to 50% of the rated deflection. Springs shall not be welded to the cups or housings.
2. Acceptable Manufacturers:
    a. Vibration Mountings and Controls, Inc.
    b. Mason Industries.
    c. Vibration Eliminator.

D. Combination Spring/Rubber Isolation Hangers:
1. Spring-Flex hangers shall consist of a steel spring in series with a .2 inch (minimum) deflection neoprene element. Springs shall be color coded, and elastomer element molded in specific colors for proper identification of rated load capacity. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Pipe isolators shall have spring diameters and hanger box lower hole sizes of sufficient size to permit the hanger rod to swing approximately 30° before contacting the box. Hangers which are to be used with flat iron duct straps will be provided with eye bolts on both ends.
2. Acceptable Manufacturers:
    a. Vibration Mountings and Controls, Inc.
    b. Mason Industries.
    c. Vibration Eliminator.

E. Spring/Rubber Pre-Positioning Hangers:
1. Spring-Flex hangers shall consist of color-coded steel spring in series with a neoprene element molded in specific colors for proper identification of rated load capacity. Hanger design shall incorporate a means for supporting the suspended equipment or piping at a fixed

elevation during installation regardless of load changes as well as a means for transferring the load to the spring.

2. Acceptable Manufacturers:
   a. Vibration Mountings and Controls, Inc.
   b. Mason Industries.
   c. Vibration Eliminator.

F. Pre-Compressed Hangers:
1. Spring-Flex hangers shall consist of a color-coded steel spring in series with a neoprene element molded in specific colors for proper identification of rated load capacity. Springs shall be pre-compressed to the rated deflection so as to support the suspended equipment or piping at a fixed elevation during installation regardless of load changes. For 30° misalignment capability, spring diameters and hanger box lower hole sizes shall be of sufficient size to permit the hanger rod to swing approximately 30° before contacting the box.
2. Acceptable Manufacturers:
   a. Vibration Mountings and Controls, Inc.
   b. Mason Industries.
   c. Vibration Eliminator.

G. Spring Hangers:
1. Spring-Flex hangers shall consist of a color-coded steel spring with a neoprene and steel washer, which will properly distribute the load on the spring. For 30° misalignment capability, spring diameters and hanger box lower hole sizes shall be of sufficient size to permit the hanger rod to swing approximately 30° before contacting the box. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Hangers, which are to be used with flat iron duct straps will be provided with eye bolts on both ends.
2. Acceptable Manufacturers:
   a. Vibration Mountings and Controls, Inc.
   b. Mason Industries.
   c. Vibration Eliminator.

H. Self-Aligning Spring Hanger:
1. Spring-Flex hangers shall consist of a color-coded steel spring seated in a neoprene spring cup with integral bushing to insulate the lower support rod from the hanger box. The steel hanger box shall be hinged to allow for a minimum of 30° misalignment between the rod attachment to structure and the connection to the supported equipment. Hanger boxes shall withstand three times the rated load without failure.
2. Acceptable Manufacturers:
   a. Vibration Mountings and Controls, Inc.
   b. Mason Industries.
   c. Vibration Eliminator.

I. Floor, Wall, And Ceiling Sleeves:
1. Where piping passes through walls, floors, or ceilings, a vibration control sleeve shall be provided to reduce the transmission of vibration. The sleeve shall consist of two pipe halves with neoprene sponge material bonded to the inside and a bolting arrangement for secure fit around piping. Where temperature exceeds 240°F, an appropriate density fiberglass shall be used in place of neoprene material.
2. Acceptable Manufacturers:
   a. Vibration Mountings and Controls, Inc.

b. Mason Industries.
c. Vibration Eliminator.

J. Seismic Spring Mountings:
1. Steel spring isolator incorporating elastomeric snubbing in all directions. The snubber shall be adjustable in the vertical direction and allow a maximum of ¼" travel in all directions before contacting the elastomer cushion. Spring diameters shall be no less than 0.8 times the compressed height of the spring at rated load. Springs shall also have a minimum additional travel to solid equal to 50% of the rated deflection. Housing shall have provision to adjust the rebound plate and to inspect the spring. Housing shall be of cast ductile iron, malleable cast iron or of welded steel construction. Gray iron castings are not permitted. Springs shall be color coded for proper identification of rated load capacity. Springs shall be coated with a polyester epoxy powder. Hardware shall be stainless steel, or zinc plated.
2. Acceptable Manufacturers:
a. Vibration Mountings and Controls, Inc.
b. Mason Industries.
c. Vibration Eliminator.

K. Seismic Snubbers/Restraints:
1. All-directional seismic snubbers shall include all directional elastomer elements, having a minimum elastomer thickness of ¾" in all directions. Elastomers shall be easy to inspect and shall consist of replaceable elastomer inserts. Elastomer shall be neoprene or a high quality rubber including anti-ozone and anti-oxidant materials and conform to ASTM D2000 Grade 2BC or Bridge Bearing Neoprene. Snubbers shall be manufactured with an air gap between steel and elastomer of 1/8 inch to ¼ inch. Snubbers shall be installed with factory set clearances.
2. Snubber must have at least two anchor bolt holes and shall have an ultimate load capacity of at least four times the rated static load capacity.
3. Acceptable Manufacturers:
a. Vibration Mountings and Controls, Inc.
b. Mason Industries.
c. Vibration Eliminator.

L. Cable Restraints/Single Arm Brace:
1. Steel aircraft cable restraints are designed and installed to limit motion on suspended isolated equipment, piping or ducting. Cable are installed with enough slack to engage only when ¼ inch movement occurs. On suspended equipment, cables are installed in sets of four, located at 45° angles to all three axes. Where required at pipe hangers, cables are placed two at each location, alternating orientation at successive locations. Cable shall be 7x19 galvanized or stainless steel aircraft cable conforming to FED-STD-RR-W-410D.
2. Non-isolated equipment, pipe, and duct shall be seismically restrained with the use of a rigid brace consisting of two steel brackets designed to accept a steel angle or unistrut. Brackets shall provide easy installation by allowing full range of motion in horizontal and vertical directions. Rigid braces with slotted holes or hinges are not acceptable.
3. Acceptable Manufacturers:
a. Vibration Mountings and Controls, Inc.
b. Mason Industries.
c. Vibration Eliminator.

M. Captive Elastomer Mountings:

1. Consist of a captive elastomeric mount molded from neoprene or EPDM compound conforming to the requirements of ASTM D2000. Load bearing elastomer element shall be housed in a cast ductile iron housing. Mount shall incorporate a fail-safe captive design, and shall provide a vertical natural frequency of approximately 8 Hz at rated static load. Mount shall be capable of providing dynamic deflections of up to .5 inches.
2. Acceptable Manufacturers:
   a. Vibration Mountings and Controls, Inc.
   b. Mason Industries.
   c. Vibration Eliminator.

N. Structural Bases:
1. Integral structural steel bases shall be rectangular in shape. All structural members shall be of wide flange, angle or channel steel with depth equal to a minimum of 1/10 of the longest span of equipment, but not less than 6 inches. Built-in adjustable motor slide rails and height saving brackets shall be supplied as in integral part of the base.
2. Acceptable Manufacturers:
   a. Vibration Mountings and Controls, Inc.
   b. Mason Industries.
   c. Vibration Eliminator.

O. Structural Rails:
1. Rails for indoor applications or outdoor applications where equipment supports are mounted on isolation systems shall be of wide flange, angle or channel steel with depth equal to a minimum of 1/10 of the longest span of equipment, but not less than 6 inches. Height saving brackets shall be supplied as an integral part of the rails. For seismic applications rails must be structurally attached to one another.
2. Rails for outdoor applications where weatherproofed isolated equipment supports are required, shall be a continuous structural support rail that combines equipment support and isolation mounting into one unitized assembly. Rails shall incorporate roof-enclosed springs, which are adjustable, removable and interchangeable, after equipment has been installed. The system shall maintain the same installed and operating height with or without the equipment load and shall be capable of being utilized as a blocking device. The entire assembly shall be an integral part of the roof's membrane waterproofing. Unit to be supplied with continuous upper and lower galvanized flashing. Rails shall be cross-braced at support and equipment attachment points when used in seismic zones. Rails shall be bolted or welded to the building steel or anchored to the concrete deck to attain specified acceleration criteria.
3. Acceptable Manufacturers:
   a. Vibration Mountings and Controls, Inc.
   b. Mason Industries.
   c. Vibration Eliminator.

PART 3 - EXECUTION

3.1 GENERAL

A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.

B. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment or conduit resulting in stresses or misalignment.

C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.

D. The Contractor shall not install any isolated equipment, which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.

E. Coordinate work with other trades to avoid rigid contact with the building.

F. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. General bracing may occur from flanges to structural beams, upper truss cords in bar joist construction and cast in place inserts or wedge type drill-in concrete anchors.

G. Seismic cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment.

H. Seismic cable assemblies are installed taut on non-isolated systems. Seismic solid braces may be used in place of cables on rigidly attached systems except where single arm braces incorporate resilient bushings.

I. At locations, where seismic cable restraints or seismic solid braces are located, the support rods must be braced when necessary to accept compressive loads.

J. At all locations where seismic cable braces and seismic cable restraints are attached to pipe clevises, the clevis bolt must be reinforced with pipe clevis cross bolt braces or double inside nuts if required by seismic acceleration levels.

K. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted.

L. Where piping passes through walls, floors or ceilings, the Contractor shall provide wall seals or resilient packed pipe sleeves.

M. Special & Periodic Inspections for items listed in Section 1.03 (Article #4) shall be conducted and submitted on a timely basis.

3.2 EQUIPMENT INSTALLATION

A. Equipment shall be isolated and restrained as follows:
   1. The following equipment shall be vibration isolated:
      a. Engine-generator sets.
      b. Transformers.
      c. Uninterruptible power supplies.
   2. All floor-supported equipment shall be seismically braced.
   3. All ceiling suspended equipment shall be seismically braced.
   4. All wall-mounted equipment shall be seismically mounted.
   5. All conduit, cable tray, bus duct and wireway shall be seismically braced.

6. Exhaust piping for engine-generator sets shall be seismically braced.

B. Place floor mounted equipment on 4" high concrete housekeeping pads properly doweled or expansion shielded to the deck to meet acceleration criteria (see Section 1.06). Anchor isolators and/or bases to housekeeping pads. Concrete work is specified under Division 2.

C. Additional Requirements:
1. The minimum operating clearance under bases shall be 2".
2. 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.
3. The equipment shall be installed on blocks to the operative height of the isolators. 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. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment shall be free in all directions.
4. Ceilings containing diffusers must meet seismic zone requirements by using earthquake clips or other approved means of positive attachment to secure diffuser to T-bar structure.
5. All floor or wall mounted equipment shall be restrained.

3.3 SEISMIC RESTRAINT OF PIPING, CONDUIT, BUS DUCT AND CABLE TRAY

A. All high hazard and life safety pipe regardless of size such as fuel oil piping shall be seismically restrained. Seismic cable restraints or seismic solid braces may be used. There are no exclusions for size or distance for this category.

B. Seismically restrain all conduit seismic cable restraints or seismic solid braces may be used on unisolated conduit.

C. See the below Table for maximum seismic bracing distances.

TABLE A
SEISMIC BRACING TABLE
ON CENTER SPACING

Equip	Transverse	Longitudinal	Within Each Change Of Direction (Larger of)
Conduit	40 Feet	80 Feet	10 Ft or 15 Diameters
Bus Duct	20 Feet	40 Feet	4 Feet
Cable Tray	40 Feet	80 Feet	10 Feet

D. Multiple runs of conduit on the same support shall have distance determined by calculation.

E. Rod braces shall be used for all rod lengths greater than 3'.

F. Clevis hangers shall have spacer placed inside of hanger at seismic brace locations.

G. Transverse restraint for one conduit section may also act as a longitudinal restraint for a conduit section of the same size connected perpendicular to it if the restraint is installed within 24" of the elbow or TEE or combined stresses are within allowable limits at longer distances.

H. Hold down clamps must be used to attach conduit to all trapeze members before applying restraints.

I. Branch lines may not be used to restrain main lines.

3.4 INSPECTION

A. All independent Special and Periodic Inspections must be performed and submitted on as outlined in Section 1.05.

B. Upon completion of installation of all vibration isolation devices, the local representative shall inspect the completed project and certify in writing to the Contractor that all systems are installed properly, or require correction. The Contractor shall submit a report to the Architect, including the representative's report. Certifying correctness of the installation or detailing corrective work to be done.

END OF SECTION

SECTION 26 05 63 - ACCEPTANCE TESTING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: The work specified in this Section consists of materials to performance test electrical systems and equipment.
   1. Items Supplied Under This Section:
      a. Daylight Dimming Controls
      b. Occupancy Sensor Controls
      c. Electrical System Testing
      d. Thermographic Testing
      e. Ground System Testing
      f. Insulation Testing
      g. Equipment Testing
      h. Performance Test
      i. Test Procedure
      j. Test Report

B. Related Sections:
   1. Division 1 – General Requirements
   2. Division 26 Sections, As Applicable

1.2 REFERENCES

A. Applicable Documents and Testing Requirements of:
   1. America National Standards Institute (ANSI): as applicable, including:
      a. ANSI C2, National Electrical Safety Code.
      b. ANSI Z244.1 American National Standards for Personnel Protection.
   2. National Electrical Manufacturer's Association (NEMA): as applicable, including:
      a. NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation and Maintenance of Motor Control Centers.
      b. NEMA ICS 7.1 - Safety Standards for Construction and Guide for selection, Installation, and Operation of Adjustable Speed Drive Systems.
      c. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
      d. NEMA PB 2.1 - Proper Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
   3. American Society for Testing and Materials (ASTM), as applicable.
   4. Institute of Electrical and Electronics Engineers (IEEE), as applicable, including:
      a. IEEE C.57.13, IEEE Standard Requirements for Instrument Transformers.
   5. National Fire Protection Association (NFPA), as applicable, including:
      a. NFPA 70 - National Electrical Code (NEC).
      b. NFPA 70E - Electrical Safety Requirements for Employee Workplaces.
      c. NFPA 72 - National Fire Alarm Code (NFAC).
   6. International Electrical Testing Association (IETA) as applicable, including:

a. Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems.

7. Insulated Cable Engineer's Association (ICEA), as applicable.
8. State and Local Codes and Ordinances as applicable
9. Occupational Safety and Health Administration (OSHA), as applicable, including: Title 29, Parts 1907, 1910 and 1936.
10. International Electrical Testing Association (IETA) as applicable, including:
    a. ATS-2009: Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems.
    b. MTS-2007: Maintenance Testing Specifications for Electric Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Submit documentation as required by this Section of the Contract to the Design Engineer in strict accordance with the provisions of Section 26 05 00 for review, comments and subsequent approval.

B. Submission to include the following:
1. Field inspection report as required for each item of material and/or equipment outlined herein.
2. Manufacturer's directions for use of ground megger with proposed method indicated.

C. Test Reports:
1. Each test report prepared by the respective testing firm(s) comply, where applicable, to all stipulations specified in Section 26 05 00 for Operation, Maintenance and Installation Manuals with reference to preparation, paper requirements, indexing and binders. Include in each test report the following:
    a. Summary of project.
    b. Description of equipment tested.
    c. Description of test.
    d. Test results.
    e. Conclusions and recommendations.
    f. Appendix, including appropriate test forms.
    g. Identification of test equipment used.
    h. Signature of responsible test organization authority.
    i. Furnish five copies of each completed report to the Design Electrical Engineer no later than 30 days after completion of each test. Assemble and certify the testing firm each final test report, which must be submitted to the Design Engineer for review, comments and subsequent approval.

1.4 QUALITY ASSURANCE

A. Qualifications of Testing Laboratory: Select an independent nationally recognized testing laboratory that is independent from electrical Contractor that either is a member of The International Electrical Testing Association or meets the following qualifications:
1. Is nationally recognized as an electrical testing laboratory.
2. Has been regularly engaged in the testing of electrical systems and equipment for at least 5 years.
3. Is independent from the electrical Contractor, the Owner, the Engineer and all other Contractors on the job.

4. Has at least one Professional Engineer on staff that is licensed in the State where the project site is located.
5. Derives more than 80 percent of its income from electrical testing.
6. Owns or leases sufficient calibrated equipment to do the testing required.
7. Has a means to trace all test instrument calibration to The National Institute of Standards and Technology.

B. Membership in the International Electrical Testing Association (NETA) shall be considered evidence of meeting items A. 1. through and including A. 5.

C. Testing shall be done under the supervision of a technician certified by International Electrical Testing Association or by technicians that are both certified by the National Society of Professional Engineers and experienced in electrical testing with 5 years of testing experience.

D. The testing laboratory shall supervise or perform all testing of equipment and oversee setting of all circuit breakers and calibration of all instruments.

E. The testing firm used must be approved by the Engineer.

F. Include the cost of such tests in the Contractors Bid Price for the applicable bid item.

1.5 GENERAL REQUIREMENTS

A. Field Inspection:
1. This Contractor is responsible for a complete inspection of all equipment, prior to testing and energizing to ascertain that it is free from any damage, scratches, or missing components and that all power connections are correct, and that they are tight in conformance with recommended standard practice. The inspection is to also include a check of control wiring, terminal connections and all bolts and nuts.
2. Perform field inspection by this Contractor during a time when the Field Engineer and the Design Engineer are present to witness each inspection and its performance.
3. Correct any deficiencies found during the inspection by this Contractor prior to the energizing and testing of the equipment.

1.6 SCHEDULING

A. Schedule all testing with work of other Contractors to ensure an orderly sequence of startup and completion of work.

1.7 UNDERGROUND CONDUIT SYSTEM INSPECTION

A. General Requirements: Perform inspection of the underground conduit systems installation by a representative of the Engineer as the work progresses. Inspect each of the following prior to proceeding to the next phase of the installation.
1. Trench bed.
2. Lower sand bed.
3. Lower concrete protection slab, where indicated or required.
4. Upper sand bed for conduits.
5. Each layer of conduits.

6. Soil backfill.
7. Warning Tape.
8. Soil backfill.

B. Failure to comply with any of the above, indicated sequential inspection requirements is just cause for the Engineer to request removal of the work and reinstall as per these specifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 ELECTRICAL INSPECTIONS AND TESTS

A. Perform, supervise, and furnish all test equipment needed to perform tests and provide safety measures, procedures and equipment required for each test.

B. Schedule all testing with the Engineer. Perform testing in the presence of the Engineer except when the Engineer approves in writing conducting a specific test without the Engineer's presence.

C. Notify all involved parties including the Engineer prior to tests, advising them of the test to be performed and the scheduled date and time.

D. Coordinate the tests with others involved.

E. Prepare written test procedures and forms used in the test reports and submit for approval prior to commencement of testing.

F. Include in each test report the following information:
1. Job title.
2. Date of test.
3. Equipment, system or cable identification.
4. Type of test.
5. Description of test instrument and date of latest calibration.
6. Section of specification defining test along with description of test and evaluations as reported by the testing company.
7. Test results (correct all readings at 20 degrees C).
8. Signature of person supervising test.
9. Signature of Contractor.
10. Space for Engineer's signature.

G. Refer to individual tests and inspections hereinafter specified for any additional or specified requirements.

H. Test Instrument Calibration:
1. The testing firm is to have a calibration program, which assures that all applicable test instrumentation are maintained within rated accuracy.
2. The accuracy is to be directly traceable to The National Institute of Standards and Technology.
3. Instruments are to be calibrated in accordance with the following frequency schedule.

a. Field Instruments: Analog - 6 months maximum Digital - 12 months maximum
b. Laboratory Instruments: 12 months
c. Leased specialty equipment: 12 months

4. Make dated calibration labels visible on all test equipment.
5. Keep records up-to-date, which show date and results of instruments calibrated or tested.
6. Maintain an up-to-date instrument calibration instruction and procedure for each test instrument.
7. Calibrating standard is to be of higher accuracy than that of the instrument tested.

I. Safety and Precautions:

1. Safety practices are to include, but are not limited to, the following requirements:
   a. Occupational Safety and Health Act of 1970-OSHA.
   b. Accident Prevention Manual for Industrial Operations, National Safety Council, Chapter 4.
   c. Applicable State and Local safety operating procedures.
   d. IETA Safety/Accident Prevention Program.
   e. Owner's safety practices.
   f. National Fire Protection Association - NFPA 70E.
   g. ANSI Z244.1 American National Standards for Personnel Protection.
2. Perform all tests with apparatus de-energized except where otherwise specifically required.
3. The testing firm is to have a designated safety representative on the project to supervise operations with respect to safety.

3.2 TESTING TO BE PERFORMED BY THE CONTRACTOR

A. Daylight Dimming Controls

1. Parties responsible to execute functional test:
   a. Controls Contractor: operate the controls
   b. Electrical Contractor: assist in testing sequences
   c. Commissioning authority: to witness, direct and document testing.
2. Functions / modes required to be tested and test methods: The following testing requirements are an addition to and do not replace any testing requirements elsewhere in this Division.

Function / Mode	Test Method Manual (demonstration)
MISCELLANEOUS FUNCTIONS	
1. All specified functions and features are set up, debugged and fully operable.	Verbal discussion of features
2. Power failure and battery backup and power-up restart functions.	Demonstration
3. Occupant over-ride functions and duration setting.	Demonstration
4. Scheduling features fully functional and setup, including holidays.	Observation in terminal screens or printouts
5. Date and time setting in central computer.	Demonstration
DIMMING FUNCTIONS	
6. Test the sequence of operation for all features and modes.	Manual

7.	Test the dimming controls during "live" conditions verifying that amperage changes in light fixtures are proportional to external light changes, and that the light levels at the specified datum points remain within specified limits. Verify this over a broad area for all areas affected. Verify that all, and only, specified light fixtures are dimming.	Demonstration
8.	Verify that delays and ramp times are set and functioning so that the speed of change of light fixture output is slow enough to be judged non-bothersome to occupants.	Manual/ Demonstration
9.	Verify that dimming does not cause lower than specified light levels in adjacent "non-dimmed" spaces.	Manual
10.	Verify that the controls and sensors are not easily overridden or disabled by occupants.	Visual inspection
11.	Verify that the photo sensor is in an adequate location and is not being affected by direct sunlight or obstructions.	Visual inspection

3. Acceptance Criteria:
   a. For the conditions, sequences and modes tested, the dimming controls, integral components and related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.
4. Sampling Strategy for Identical Units:
   a. Each photosensor and its controlled zone must be tested (no sampling).

B. Occupancy Sensor Controls
1. Parties responsible to execute functional test:
   a. Controls Contractor: operate the controls
   b. Electrical Contractor: assist in testing sequences
   c. Commissioning authority: to witness, direct and document testing.
2. Functions / modes required to be tested and test methods: The following testing requirements are an addition to and do not replace any testing requirements elsewhere in this Division.

Function / Mode	Test Method Manual (demonstration)
MISCELLANEOUS FUNCTIONS	
1. All specified functions and features are set up, debugged and fully operable.	Verbal discussion of features
2. Power failure and battery backup and power-up restart functions.	Demonstration
3. Occupant over-ride functions and duration setting.	Demonstration
4. Scheduling features fully functional and setup, including holidays.	Observation in terminal screens or printouts
5. Date and time setting in central computer.	Demonstration
OCCUPANCY SENSOR FUNCTIONS	
6. Verify 100% of occupancy sensors cover the entire space at its mounting location and adjusted angle.	Manual/Demonstration
7. Verify 100% of passive infra-red sensor types have their lens adjusted for the space geometry and size of space. Verify their sensitivity is adjusted for coverage of entire space.	Manual

8.	Verify 100% of ultrasonic sensor types have their sensitivity adjusted for coverage of entire space.	Manual
9.	Verify sensitivity adjustment for both types of sensors does not trigger nuisance trips from air diffusers close to the sensor.	Manual/Demonstration
10.	Verify sensitivity adjustments for both types of sensors eliminates trips from movement in adjacent space.	Manual/Demonstration
11.	After room lighting circuit is triggered on from an occupancy sensor, confirm programmed delay off time is functional. Temporarily reprogram the delay off time to expedite testing. If reprogrammed, verify final programmed delay off time matches specifications.	Manual/Demonstration

3. Acceptance Criteria:
   a. For the conditions, sequences and modes tested, the occupancy controls, integral components and all related equipment respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice.
4. Sampling Strategy for Identical Units:
   a. Of the total controlled room lighting circuits, 10% should be tested to confirm occupancy sensor controls. If 10% of the first group fails the test, select another 10% of the total room lighting circuits. If the 10% of these rooms fail, test all remaining rooms fully at the Contractor's expense.

C. Continuity Test: Make test for continuity and correctness of wiring and identification on all conductors installed.

D. Wire and Cable:
1. Test all wires and cables sized No. 2 and larger in accordance with NETA ATS- 2009.
2. Perform visual, mechanical, and electrical tests on all No. 4 and No. 6 power cables that operate at voltages exceeding 150 volts to ground in accordance with NETA ATS-2009.
3. Perform visual, mechanical, and electrical tests on all other wires and cables in accordance with NETA ATS-2009.
4. Replace any wires which have been damaged.
5. Correct causes of all readings which do not meet the acceptable minimum insulation readings are as stated in NETA ATS-2009. Exceed the nominal expected temperatures for the actual load.
6. Retest items requiring correction.

E. Surge Protective Device (SPD):
1. Visually and mechanically inspect the SPD unit and connections.
2. Use an AC voltmeter to check all voltages and ensure that normal operating voltages of the power system match the voltage rating on the SPD nameplate.
3. Check LED status indicators on the display panels and suppression modules to confirm normal status.
4. Press the alarm test button to confirm the audible alarm and LED.
5. Operate the alarm silence switch to confirm proper operation.

F. Ground Fault Circuit Interrupter (GFCI) Receptacles:
1. Test all GFCI receptacles as specified in Section 26 27 26.

G. Initial Mechanical Performance Test

1. Provide on-site electricians and support to the general Contractor during the mechanical performance test.
2. With the personnel of the Owner observing, demonstrate to the satisfaction of the Engineer the mechanical performance of each item of equipment when operated in accordance with the design intent indicated by the Drawings and described in the applicable sections of the Specifications.
3. Correct all deficiencies and demonstrate that they have been corrected.
4. Without reliance on Owner's personnel, operate and maintain the equipment in continuous, day to day, 24 hour operation until commencement of the Final Mechanical Performance Test.
5. During this interim, instruct and train the Owner's personnel in their duties.
6. Final Mechanical Performance Test: During a 48-hour period.
    a. With equipment in continuous normal operation, under supervision turn operation of the plant over to the personnel of the Owner beginning with the final tests.
    b. Demonstrate that equipment is coordinated and that installation complies with the applicable Drawings and Specifications.
    c. Measure all major feeders, the total power, total power factor, current on all lines, and voltage, phase and phase to ground, and on all phases.
    d. Measure all motors over 5 horsepower, power, power factor and voltage under load.
    e. Correct all deficiencies and demonstrate that they have been corrected.
    f. Owner will pay operating costs for the Final Mechanical Performance Tests.
    g. Test will be considered complete after a continuous 48-hours of satisfactory operation without any failure of equipment.

H. Test Interim:
1. Contractor's Personnel, without reliance of Owner's Personnel, are to operate and maintain the equipment in continuous, day to day, 24 hour operation except as otherwise approved by the Engineer until commencement of the Final Mechanical Performance Test.
2. During this interim the Contractor's Personnel are to instruct and train the Owner's Personnel in their duties.

I. Final Mechanical Performance Test: Final Mechanical Performance Test is to cover a 48 hour period while the plant is in continuous, normal operation.
1. With equipment in continuous, normal operation, the Personnel of the Owner are to assume day to day operation of the equipment under the direct supervision of the Contractor's Personnel beginning with the Final Tests.
2. Contractor's Personnel are to demonstrate to the satisfaction of the Engineer that equipment is coordinated and that installation complies with the applicable Drawings and Specifications.
3. Performance Tests are to be considered concluded at the end of the forty-eight hour period designated for the tests if the Engineer is satisfied with the test results or should deficiencies be found as a result of said test, then when the deficiencies have been corrected to the satisfaction of the Engineer.

J. Operating Costs: Costs for Final Mechanical Performance Tests: The Owner will pay operating costs for the Final Mechanical Performance Tests except those costs for chemicals required to complete Process Performance Tests and Acceptance Tests, if required on equipment.

3.3 TESTING TO BE PERFORMED BY THE TESTING LABORATORY

A. Select, hire and pay an independent nationally recognized electrical testing laboratory to perform all testing specified in this article. Obtain Owner's approval of the testing laboratory and the testing laboratory proposed test procedure prior to commencement of any tests.

B. Set all adjustments for all overcurrent protection devices in accordance with the protection and coordination study of Section 26 05 00.

C. Visually and mechanically inspect and electrically test items as scheduled in attached schedule for equipment in attached schedule equipment as listed in attached schedule in using the procedures of NETA ATS-2009. When a test for a particular item is not called out in ATS, test using the procedures in NETA MTS-2007.

D. Thermographic Inspection:

1. Perform thermographic inspection of the electrical equipment and installations as listed below in accordance with NETA ATS-2009, and as detailed below. The following equipment is to be scanned:

a.	Switchboards	all ratings
b.	Switchgear	all ratings
c.	Service Entrance Panelboards	all ratings
d.	Distribution Panelboards	50-Ampere and larger
e.	Lighting Panelboards	50-Ampere and larger
f.	Power Panelboards	50-Ampere and larger
g.	Motor Control Centers	all ratings
h.	Dry Type Transformers	10 kVA and Larger
i.	Individually Mounted Circuit Breakers	100 amp and larger
j.	Disconnect Switches	100 amp and larger
k.	Individually Mounted Motor Starters	Size 1 and larger
l.	Motors	30 HP and larger

2. Provide report including the following items:
   a. Items scanned
   b. Whether item passed or failed
   c. All items in NETA ATS-2009
   d. The probable cause
   e. Severity of defect
   f. Recommended corrective measures
   g. Video recording of test.
3. Scan using an infrared camera with video scanner output to a display screen with a range of at least 1 degree C to 75 degrees C with an accuracy of 0.1 degree C and with the following equipment:
   a. One 7 degree telephoto lens
   b. One 20 degree wide angle lens
   c. One 40 degree extra-wide angle lens
4. Record output of camera during testing onto a DVD or store digital images of each piece of equipment inspected onto a CD as a record of the temperature variations. Record either by order or by digital imprinting the actual equipment being scanned. Turn off recordings during inactive periods or edit DVD to eliminate dead periods.
5. Display data on a monitor capable of providing both a gray step mode and color monitor. These capabilities allow distinct temperature levels to be shown in black and white and color on the thermogram.

6. Submit three copies of report and two copies of the DVD or CD.
7. Include DVD or CD of thermographs of the defective equipment and installations. Also include in report.
8. Submit both copies of the report to the Engineer who will make the determination of corrective measurements.

E. Lighting Tests
1. Emergency, standby, equipment and lighting test-trip all incoming utility power and ascertain that all standby and emergency equipment operates. Additionally measure lighting levels on all egress paths, at each stair landing at middle of stairs, at changes in direction at doorways and every 25' along path. Replace and correct defective equipment. However report lighting levels to engineer. Correction of low lighting levels will be by change order as needed. Operate battery systems for emergency lighting without power for 90 minutes and correct all defects and retest.

F. Medium Voltage Switchgear Tests:
1. Visually and mechanically inspect and electrically test all medium voltage switchgear, in accordance with NETA ATS-2009.
2. Acceptable values are as stated in NETA ATS-2009.
3. Test all components as specified in this Section.

G. Medium Voltage Motor Controller Tests:
1. Visually and mechanically inspect and electrically test all medium voltage switchgear, in accordance with NETA ATS-2009.
2. Acceptable values are as stated in NETA ATS-2009.
3. Test all components as specified in this Section.

H. Liquid Filled Transformers Tests:
1. Visually and mechanically inspect and electrically test liquid filled transformers in accordance with NETA ATS-2009.
2. Acceptable values are as stated in NETA ATS-2009.

I. Metal Enclosed Medium Voltage Air Switch Tests:
1. Visually and mechanically inspect and electrically test all medium voltage air switches rated over 600 volts in accordance with NETA ATS-2009.
2. Acceptable values are as stated in NETA ATS-2009.

J. Low Voltage Molded Case Circuit Breaker Tests:
1. Visually and mechanically inspect and electrically test all low voltage circuit breakers in frame sizes rated 100-amperes or more in accordance with NETA ATS-2009.
2. Acceptable values are as stated in NETA ATS-2009.

K. Instrument Transformer Tests:
1. Visually and mechanically inspect and electrically test all instrument transformers in accordance with NETA ATS-2009.
2. Acceptable values are as stated in NETA ATS-2009.

L. Metering Tests:
1. Visually and mechanically inspect and electrically test all meters using standards traceable to The National Institute of Standards and Technology in accordance with NETA ATS-2009.
2. Meters should be accurate to within their stated calibration.

M. Grounding Electrode System Tests:

1. Visually and mechanically inspect and electrically test all made grounding electrode systems in accordance with NETA ATS-2009. For the point-to-point tests of NETA ATS-2009, measurements are only required for equipment conductors run with services, and feeders and branch circuits rated over 400 amperes.
2. Determine acceptable values as follows:
   a. Main service entrance ground: 5 ohms.
   b. Emergency/standby generator ground grid: 5 ohms.
   c. Panelboards ground bus: 10 ohms.
   d. Manhole ground rod electrodes: 25 ohms
   e. Prior to the electric service being energized and prior to the installed products being covered, measure the ground system resistance to earth in the presence of the Engineer.
   f. Grounds not otherwise covered in this Specification with a maximum of 25 ohms.
   g. For continuity tests, determine the acceptable value for the equipment grounding conductor by the following formula:

$$R_{EquipGndCond} \leq 0.1x\frac{V_{LineToGnd}}{I_{OverCurrentProtection}}$$

Where the following definitions apply:

$R_{equipGndCond}$ = The measured resistance of the Equipment Grounding Conductor.

$V_{linetoGnd}$ = The Nominal Line to Ground Voltage of the circuit or feeder.

$I_{overcurrentprotection}$ = The Trip, or Melting Current of the overcurrent protective device for the circuit.

N. Medium Voltage Surge Arrectors Tests:

1. Visually and mechanically inspect and electrically test all medium voltage surge arrectors in accordance with NETA ATS-2009.
2. Acceptable values are as stated in NETA ATS-2009.

O. Low Voltage Switchboard Tests:

1. Visually and mechanically inspect and electrically test all low voltage switchboards in accordance with NETA ATS-2009.
2. Acceptable values are as stated in NETA ATS-2009.
3. Test all components as specified in this Section.

P. Motor Control Centers

1. Visually and mechanically inspect and electrically test all low voltage motor control centers in accordance with NETA ATS-2009.
2. Acceptable values are as stated in NETA ATS-2009.
3. Test all components as specified in this Section.

Q. Dry-Type Transformers Tests:

1. Visually and mechanically inspect and electrically test low voltage dry-type transformers in sizes rated over 7.5 kVA, 3-phase and rated less than 500 kVA, 3-phase in accordance with NETA ATS-2009.
2. Acceptable test values are as stated in NETA ATS-2009.

R. Ground Fault Protection Testing:
1. Visually and mechanically inspect and electrically test all ground fault protection systems in accordance with NETA ATS-2009.
2. Acceptable test values are as stated in NETA ATS-2009.

S. AC Motor Testing:
1. Visually and mechanically inspect and electrically test all AC motors rated 10- horsepower or more in accordance with NETA ATS-2009.
2. Acceptable test values are as stated in NETA ATS-2009.
3. Immediately report all motors, which fail inspection to the Engineer for correction.

T. Low Voltage Motor Starter Tests:
1. Visually and mechanically inspect and electrically test all low voltage motor starters rated 10-horsepower or more in accordance with NETA ATS-2009.
2. Acceptable values are as stated in NETA ATS-2009.

U. Voltage Adjustment:
1. Measure the plant voltage with the plant operated at both no load and at nominal load at the following locations.
   a. Main Distribution Switchboard.
   b. Each panelboard bus.
2. Adjust all transformer taps to bring the no-load voltage above nominal, but in no case, higher than 105.8% of nominal. Adjust the operated loaded voltage to a value above 91.7%, (ANSI Range A), with only momentary excursions to a maximum of 105.8% and a minimum of 88.3% for all loads and 86.7% for motor loads. (ANSI Range B).
3. After all adjustments have been made, re-measure all voltages.
4. For record purposes measure and record on all 3-phases, actual plant load at all switchboard and panelboard buses.
5. With a minimum/maximum recording voltmeter measure starting voltage dip for the largest motor at:
   a. Starter terminals.
   b. Panelboard.
   c. Main Distribution Switchboard.
6. Measure minimum/maximum/average voltage at Main Distribution Switchboard over a 24 hour period with the plant running on at least one phase with recording voltmeter.

V. Harmonic Testing
1. Conduct harmonic testing at:
   a. Main Distribution Switchboard.
   b. Points of Common Coupling (PCC). PCC defined as nearest switchboard or panelboard which directly serves each variable frequency drive.
   c. Generator terminals.
   d. Transformer primary terminals.
2. Measure and record the following data at each location where harmonic testing is required:
   a. Current Distortion: Total harmonic distortion (THD) and individual harmonic components up to and including the 35th harmonic.

b. Voltage Distortion: Total harmonic distortion (THD) and individual harmonic components up to and including the 35th harmonic.
c. Voltage Notching: Notch area (volt-microseconds) and depth (volts).
d. For record purposes measure and record on all 3-phases, actual plant load at all switchboard and panelboard buses.

3. Conduct harmonic testing with harmonic producing loads in operation. Record the following information for variable frequency drives, taken at the time harmonic distortion measurements are made:
   a. Output frequency.
   b. Output current.
   c. Output voltage.
   d. Output power factor when motor metering includes this capability.
4. Conduct harmonic testing with variable frequency drives operating at full load and half load.
5. Test report shall include the following calculated values at each location where harmonic testing is required:
   a. Total demand distortion (TDD).
   b. Individual harmonic current distortion in percent of the maximum demand load current up to and including the 35th harmonic.

W. Power Conditioning Units Testing:
1. Visually and mechanically inspect the power conditioning unit and connections.
2. Tests and measurements shall be made at the panelboard immediately downstream from the power conditioning unit. Voltages shall be measured and recorded for all three phases.
3. Tests:
   a. Steady state voltage regulation for steady state loads varying from no load to full load. Acceptable test result: +/- 1.0%.
   b. Step voltage regulation for 25% step load, 50% step load and 100% step load. Acceptable test result: +/- 5.0%, +/- 8.0% and +10/-8%, respectively.
   c. Step load recovery time to +/- 1.0% voltage with up to 100% step. Acceptable test result: Within 1 cycle.
   d. Voltage distortion: Total harmonic distortion (THD) and individual harmonic components up to and including the 35th harmonic. Acceptable test result: 5.0% total harmonic distortion, 3% any single frequency.
   e. Phase angle with up to 30% unbalanced load. Acceptable test result: +/- 3.0%.
4. For record purposes measure and record on all 3-phases, actual voltage and voltage distortion (total harmonic distortion and individual harmonic components up to and including the 35th harmonic) at the input to the power conditioning unit.

3.4 TESTING TO BE PERFORMED BY MANUFACTURER'S REPRESENTATIVE

A. Emergency Generator Tests:
1. On completion of the installation, the initial start-up shall be performed by a factory-trained representative of the generator supplier. Two copies of operating and maintenance instruction books shall be supplied for the test of the generator set and such auxiliary equipment as may require same.
2. Provide equipment manufacturer's certification that the power generation equipment is installed, inspected, tested, adjusted and approved satisfactory by equipment manufacturer's service engineer.
3. Provide lubricating oils, lubrication, coolant water treatment and anti-freeze solution, Prestone or as approved, to -30 degrees F. (1 degree C.) fuel, electrical instruments, portable

load bank, etc., as required for tests. Load bank shall be similar to those manufactured by Avtron Manufacturing Inc., Cleveland, Ohio.

4. With Owner's operating personnel observing, demonstrate to the satisfaction of the Engineer the mechanical performance of power generation equipment, when operated in accordance with design intent of the Drawings and Specifications, and when tested with a portable load bank as follows:
   a. Start and idle for ten minutes.
   b. Operate generator set at 25 percent rated load for 10 minutes.
   c. Operate generator set at 50 percent rated load for 30 minutes.
   d. Operate generator set at 75 percent rated load for 30 minutes.
   e. Operate generator set at 100 percent rated load for three hours.
5. Record voltage, frequency, load current, oil pressure and coolant temperature at periodic intervals during test.
6. Prior to acceptance, any defects, which become evident during this test shall be corrected by this Contractor at no additional cost to the Owner.
7. After acceptance of performance test:
   a. Change oil, oil filters and fuel filters.
   b. Fill fuel tanks.
   c. Provide one complete spare set of filters and related gaskets as specified hereinbefore.
   d. Instruct Owner's personnel regarding equipment operation and maintenance procedures.
8. Furnish copies of complete lists of spare parts and special tools recommended for 2 years of normal operation of the complete system including the manufacturer's name, addresses, catalog numbers and prices.

B. Automatic Transfer Switch Tests:
1. On completion of the installation, the initial start-up shall be performed by a factory-trained representative of the generator supplier. Two copies of operating and maintenance instruction books shall be supplied for the test of the automatic transfer switches.
2. Provide equipment manufacturer's certification that the automatic transfer switch equipment is installed, inspected, tested, adjusted and approved satisfactory by equipment manufacturer's service engineer.
3. Visually and mechanically inspect and electrically test automatic transfer switches in accordance with NETA ATS-2009.
4. Acceptable values are as stated in NETA ATS-2009.
5. Instruct Owner's personnel regarding equipment operation and maintenance procedures.
6. Furnish copies of complete lists of spare parts and special tools recommended for 2 years of normal operation of the complete system including the manufacturer's name, addresses, catalog numbers and prices.

C. AC Variable Frequency Drive (VFD) Tests:
1. On completion of the installation, the initial start-up shall be performed by a factory-trained representative of the AC drive manufacturer. Two copies of operating and maintenance instruction books shall be supplied for the test of the AC drives.
2. Provide equipment manufacturer's certification that the AC drives are installed, inspected, tested, adjusted and approved satisfactory by equipment manufacturer's service engineer.
3. Instruct Owner's personnel regarding equipment operation and maintenance procedures.
4. Furnish copies of complete lists of spare parts and special tools recommended for 2 years of normal operation of the complete system including the manufacturer's name, addresses, catalog numbers and prices.

D. Active Harmonic Filters Tests:
   1. On completion of the installation, the initial start-up shall be performed by a factory-trained representative of the Active Harmonic Filters manufacturer. Two copies of operating and maintenance instruction books shall be supplied for the test of the Active Harmonic Filters.
   2. Provide equipment manufacturer's certification that the Active Harmonic Filters are installed, inspected, tested, adjusted and approved satisfactory by equipment manufacturer's service engineer.
   3. Instruct Owner's personnel regarding equipment operation and maintenance procedures.

E. Furnish copies of complete lists of spare parts and special tools recommended for 2 years of normal operation of the complete system including the manufacturer's name, addresses, catalog numbers and prices.

3.5 CORRECTION OF DEFICIENCIES

A. Report all unacceptable values immediately. Correct all deficiencies found in work of this contract and separately report deficiencies in work of items of other contracts.
   1. Retest items requiring correction. Correct or have corrected any remaining deficiencies and retest until work is acceptable.

3.6 RETESTING

A. After equipment has been in service for a period of nine months repeat the following tests:
   1. Thermographic testing. Correct all causes of readings above the nominal expected reading for the load encountered.
   2. Insulation tests of all motors over 100 horsepower, switchgear, switchboards, and transformers over 50 kVA.

END OF SECTION

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SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: The work specified in this Section consists of all materials for furnishing, installing connecting, energizing, testing, cleaning and protecting wall- mounted panelboards.

B. Related Section:
1. Section 26 05 00 – Common Work Results for Electrical
2. Section 26 05 28 - Hangers and Supports for Electrical Systems
3. Section 26 05 53 - Identification for Electrical Systems
4. Section 26 05 63 - Acceptance Testing for Electrical Systems
5. Section 26 05 19 - Low Voltage Electrical Power Conductors and Cables
6. Section 26 43 13 - Surge Protective Devices (SPD)

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. ASTM B164 Nickel-Copper Alloy, Bar and Wire.
2. ASTM B187 Standard Specifications for Copper Bus, Bus Bar, Rod and Shapes

B. National Electrical Manufacturers Association (NEMA):
1. NEMA 250 Electrical Enclosures.
2. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches.
3. NEMA AB 2 Molded Case Circuit Breakers and their Application.
4. NEMA PB 1 Panelboards.
5. NEMA PB 1.1 General Instructions for Proper installation, Operation, and Maintenance of Panelboards.

C. National Fire Protection Association (NFPA):
1. NFPA 70 National Electrical Code (NEC).

D. Underwriters Laboratories (UL):
1. UL 489 Molded Case Circuit Breakers and Circuit Breaker Enclosures
2. UL 50 Cabinets and Boxes
3. UL 67 Panelboards

1.3 SYSTEM DESCRIPTION

A. Panelboards are connected to system voltages as follows:
1. Not used.
2. 208Y/120 Volt, 3-phase, 4-wire.
3. 120/240 Volt, 1-phase, 2-wire.

Addendum 6

1.4 SUBMITTALS

A. Testing Agency/Quality Verification: Provide with all product data evidence of testing agency/quality verification, listing, and labeling either by printed mark on the data or by a separate listing card. Provide from product manufacturers a written statement indicating why an item does not have a quality assurance verification. Such statements are subject to the approval of the Engineer.

B. Product Data and Catalog Cuts: Provide product data for all products provided. Indicate clearly the usage and designation of each product.

C. Shop Drawings: Submit shop drawings for all panelboards.

D. Provide manufacturer's instructions for all panelboards.

1.5 SHORT CIRCUIT, ARC-FLASH, PROTECTIVE DEVICE COORDINATION AND HARMONIC DISTORTION STUDY

A. The computerized short-circuit, arc-flash, protective coordination and harmonic study will be performed and submitted as outlined in Section 26 05 00 of these specifications.

B. The Contractor is responsible for supplying the necessary and required information in order that this study may be completed and submitted at least two full calendar weeks prior to submitting Shop Drawings for equipment included the respective studies, submit the preliminary studies and corresponding computer printouts and annotated one-line distribution diagram to the Engineer for review and comment.

1.6 QUALITY ASSURANCE

A. Provide panelboards, which have been design tested in accordance with NEMA PB 1.

B. Provide panelboards which have been production tested in accordance with NEMA PB 1.

C. Conform all work to NFPA 70, National Electrical Code.

D. Install work under supervision of licensed electricians

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Basic Electrical Materials: Those products such as conduit, wireways, wire and connectors, cable, support devices, fasteners, and similar devices as required for work of this Section are as specified in other Sections of these Specifications.

2.2 PANELBOARDS

A. Provide dead-front panelboards as follows:
   1. Accommodate bolt-on molded case circuit breakers as specified below.
   2. Conform to NEMA PB 1 and NFPA 70, Article 384.
   3. Consist of interiors, matching enclosures and covers of a single manufacturer as specified below.
   4. Have circuit breakers of frame sizes, trip ratings, number of poles, and types as scheduled, indicated and noted.
   5. Provide branch circuits phased in sequence vertically and numbered uniformly left to right, top to bottom.

B. Provide panelboards that are fully rated for a short circuit capacity as scheduled, indicated and noted on the Drawings.

C. Interiors: Provide interiors, as follows:
   1. Provide tin plated main, ground and neutral copper buses conforming to ASTM B187 having not less than 98 percent conductivity.
   2. Mount interiors on galvanized steel backplate.
   3. Make provisions for future breakers and for circuit breakers in all future spaces as indicated, scheduled or noted and so that additional breakers can be mounted without additional connectors or extension of busses.

D. Provide solderless type main, sub-feed, and through feed lugs rated for copper and aluminum conductors of size, number and type, as indicated, scheduled and noted on the Drawings.

E. Enclosures:
   1. Provide enclosures conforming to NEMA 250 for the types as indicated, scheduled, noted, and specified. Provide NEMA 1 enclosures unless otherwise indicated on the Drawings.
   2. Fabricate from galvanized steel without knockouts.
   3. Provide side, bottom, and top gutters of minimum 4-inch (10cm) width, of minimum 5-1/2 inch (14cm) depth, and sized as indicated, scheduled, and noted and as required by NFPA 70 Article 373 for the actual entry point.
   4. Provide circuit directory of sufficient size to allow 40-characters per circuit; indicate the source of service (i.e. upstream panelboard, switchboard, motor control center, etc.) to the panelboard. Mount the directory in a transparent protective covering.

F. Doors: Provide doors as follows:
   1. Provide concealed hinges and trim clamps.
   2. Provide combination catch and master keyed, flat key lock with two keys for each lock and common keying throughout each building of the facility.

G. Finishes:
   1. Factory finish enclosure cover completely using an electro-deposition process that deposits a complete finish coat of paint on all interior and exterior surfaces as well as bolted joints.
   2. Include in the paint process cleaning, rinsing, phosphatizing, prepaint and post paint rinses, bake-cure and cool down steps.
   3. Finish switchboards with rust inhibiting primers and electro-disposition acrylic baked enamel top coating of No. 49 medium light grey conforming to ANSI Z55.1.
   4. Provide overall finish capable of passing a 300-hour salt spray per ASTM B117 with less than 1/8 loss of paint from a scribed line.

H. Molded case circuit breakers:
   1. Provide inverse time and instantaneous tripping characteristics.
   2. Provide trip ratings, frame sizes, and number of poles as indicated, scheduled, and noted on the Drawings.
   3. Provide full rated circuit breakers with short circuit ratings equal to the panelboard installed as scheduled on the Drawings.
   4. Provide molded case circuit breakers conforming to NEMA AB 1, and UL 489.
   5. Provide circuit breakers of the same manufacture and type as the panelboard installed.
   6. New circuit breakers for existing panelboards or loadcenters shall match the existing circuit breaker type, manufacturer, and AIC rating. Circuit breakers that are added into existing equipment shall be new, unless noted on the drawings as existing to be relocated and/or reused; and shall be purchased from an authorized manufacturer's distributor. Purchase of used, reconditioned, or brokered circuit breakers is prohibited unless approved by the Engineer.

I. Surge Protective Devices (SPD): Provide a Surge Protective Device as specified in Section 26 43 13. Factory install and wire SPD within the panelboard prior to shipment to the job site. Mount SPD audible alarm, alarm silence and test switches, and failure indicators (LEDs) on front of panelboard. Provide terminal blocks for external circuit connections.

J. Panelboard Types:
   1. Distribution - Square D I-Line.
   2. Branch Power and Lighting (208Y/120V) - Square D NQOD.
   3. Not used
   4. Not used

K. Acceptable Manufacturers:
   1. Square D Company
   2. Eaton Electric
   3. General Electric
   4. Siemens Industry for LV Power Distribution
   5. Or Approved Equal

PART 3 - EXECUTION

3.1 PREPARATION

A. Painted surfaces, which will be covered by items of this Section have a prime and finish coat of paint.

B. Ensure that all indoor areas are enclosed from the weather.

3.2 INSTALLATION

A. Space enclosures out from surfaces mounted on 1/4-inch (6mm) spacers or U- channel supports. Provide supports as specified in Section 26 05 28.

B. Install all panelboards and circuit-breakers in accordance with the manufacturer's instructions and NEMA PB 1.1.

C. Set enclosure top 6-feet 6-inches above finished floor or grade unless otherwise indicated or specified.

D. Punch holes for conduit entries in the enclosures.

E. In all areas except dry areas, install conduit drain fitting in punched hole in bottom of enclosure, conduit breather fitting in top of enclosure.

F. Interface with other work:
1. Connect conduits to enclosure with watertight hubs, except in damp locations on the bottom of enclosures a sealing locknut may be used in place of watertight hubs, and in dry locations two locknuts and bushings may be used.
2. Connect wiring to line and load terminals with lugs provided or approved by manufacturer in conformance with Section 26 05 19. Remove interior or protect interior components during wire pulling.
3. Identify in accordance with Section 26 05 53.

G. At the end of the project update the circuit directories to reflect as-built conditions. Circuit directions shall be typed.

3.3 CLEANING

A. After wiring, vacuum out interior and wipe clean of all foreign material.

B. After painting in areas, remove all over paint, drips and splashes.

3.4 FIELD QUALITY CONTROL

A. Site Testing:
1. Prior to Energizing:
   a. Have insulation testing and setting of overcurrent protective device adjustments made in conformance of Section 26 05 63.
   b. Ensure that all load side wiring is clear of shorts and has received and passed the insulation tests of Section 26 05 63.
   c. Open all downstream disconnects and open circuit breaker.
2. Final testing after energizing:
   a. Perform thermographic test and record circuit parameters in conformity with Section 26 05 63.

3.5 PROTECTION

A. During painting, mask all nameplates, all plastic parts, and all items not to be painted.

B. Protect all items during work of other trades including welding and cutting.

C. Protect panelboards against overloads, short circuits, and improper operation, padlock off when work is being done on downstream circuits.

END OF SECTION

SECTION 26 28 16.13 - LOW VOLTAGE ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for furnishing, installing, connecting, energizing, testing, cleaning, and protecting enclosed disconnect switches, hazardous location switches, and fuses.

B. Related Sections:
   1. Section 26 05 28 - Hangers and Supports for Electrical Systems.
   2. Section 26 05 53 - Identification for Electrical Systems.
   3. Section 26 05 63 - Acceptance Testing for Electrical Systems.
   4. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.

1.2 REFERENCES

A. InterNational Electrical Testing Association, Inc. (NETA):
   1. ANSI/NETA ETT Standard for Certification of Electrical Testing Technicians.

B. National Electrical Manufacturers Association (NEMA):
   1. NEMA 250; Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA KS 1; Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

C. National Fire Protection Association (NFPA):
   1. NFPA 70; National Electrical Code (NEC).

D. Underwriter’s Laboratories, Inc. (UL):
   1. UL 98; Standard for Enclosed and Dead-Front Switches.

1.3 SUBMITTALS

A. Submit the following information for approval in accordance with the requirements of Section 01 33 00, Submittal Procedures:
   1. Product Data:
      a. Enclosed disconnect switches
      b. Enclosed hazardous location switches
      c. Fuses
   2. Shop Drawings:
      a. Enclosed disconnect switches
      b. Enclosed hazardous location switches
   3. Quality Assurance/Control Submittals:
      a. Certificates:
         1) Testing agency/quality verification listing cards, if required

2) Manufacturers written statement indicating why items do not have quality assurance verification, if required

b. Manufacturer's instructions:
1) Enclosed disconnect switches

c. Qualification Statements:
1) Electrical testing laboratory's qualifications

1.4 SHORT CIRCUIT, ARC-FLASH, PROTECTIVE DEVICE COORDINATION AND HARMONIC DISTORTION STUDY

A. The computerized short-circuit, arc-flash, protective coordination and harmonic study will be performed and submitted as outlined in Section 26 05 00 of these specifications.

B. The Contractor is responsible for supplying the necessary and required information in order that this study may be completed and submitted at least two full calendar weeks prior to submitting Shop Drawings for equipment included the respective studies, submit the preliminary studies and corresponding computer printouts and annotated one-line distribution diagram to the Engineer for review and comment.

1.5 QUALITY ASSURANCE

A. Qualifications:
1. Installer Qualifications:
a. Employ licensed electricians to supervise installation of the work of this Section.
2. Electrical Testing Laboratory (ETL) Qualifications:
a. Use a NETA accredited electrical testing laboratory, or approved equal, that is accredited according to ANSI/NETA ETT for the region in which the Contract work is performed.
b. Submit the electrical testing laboratory's qualifications to the Engineer for approval.

B. Regulatory Requirements:
1. Conform all work to NFPA 70, the National Electrical Code.

C. Certifications:
1. Provide products that are either listed and labeled by Underwriters Laboratory, approved by Factory Mutual, or certified as meeting the standards of UL by the Electrical Testing Laboratory (ETL) for the location installed in, and the application intended, unless products meeting the requirements of these testing laboratories are not available or unless standards do not exist for the products.

1.6 MAINTENANCE

A. Extra Materials:
1. Provide one set of spare fuses for each point of use including all of the ampere sizes indicated for the location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Use of Trade Names:
1. The use of trade names within the Contract Documents is intended to establish the basis of design and to illustrate the constructability and level of quality required.
2. The use of trade names is not intended to exclude other manufacturers whose products are equivalent to those named, subject to compliance with Contract requirements.

2.2 MANUFACTURED UNITS

A. Enclosed Disconnect Switches:
1. Provide enclosed disconnect switches that meet the requirements of NEMA KS l and UL 98, and that are as shown on the Contract Drawings.
a. Types:
1) Heavy duty fusible type.
a) Provide positive pressure fuse clips.
b) Provide fuses as specified
2) Heavy duty non-fusible type.
b. Provide enclosed disconnect switches rated for the horsepower, voltage, and amperage as indicated on the Contract Drawings.
c. Provide enclosed disconnect switches with the number of poles and of the type indicated on the Contract Drawings.
2. Enclosure:
a. Provide enclosures consisting of a box and cover conforming to the requirements of NEMA 250 and of the type indicated or scheduled on the Contract Drawings.
1) If not otherwise specified, provide enclosures conforming to the requirements of NEMA 250, type 1.
b. Material:
1) Construct enclosures of code gauge sheet steel per the requirements of UL 98.
c. Finish:
1) Apply a rust-inhibiting phosphate coating to the enclosure’s sheet steel, and then finish the enclosure in gray baked enamel.
d. Provide a permanent label with the manufacturer's switch type, catalog number, and horsepower rating on the enclosure.
3. Switch Mechanism:
a. Provide a quick-make, quick-break operating handle and switch mechanism integral to the box or body, not the cover.
1) Provide dead front construction with permanent arc suppressors and dual cover interlocks to prevent an unauthorized opening of the switch enclosure when the switch is in the ON position.
2) Provide the means to positively padlock the switch in the OFF position.
b. Provide a switch designed so that the switch blades are visible in the OFF position when door is open.
c. Provide UL-listed switch lugs for front removable copper cables.
d. Electroplate the switch’s current carrying parts to provide resistance to corrosion.
4. Acceptable Manufacturers:
a. Square D Company
b. Eaton Electric

c. General Electric
d. Siemens Industry for LV Power Distribution
e. Or Approved Equal

B. Hazardous Location Switches:
1. For hazardous areas having explosive vapors and/or gases present, provide UL- listed, heavy-duty safety switches rated for Class 1, Division 1 environments as defined in NFPA 70.
2. Enclosure:
a. Provide enclosures that conform to the NFPA 70 requirements for equipment to be used in Class 1, Division 1 locations.
1) Provide the type of enclosure indicated or scheduled on the Contract Drawings in accordance with the requirements of NEMA 250.
2) Provide threaded covers at each end of the enclosure set at an angle to facilitate wiring.
a) Provide enclosures designed so that the interior of the enclosure is readily accessible through the threaded cover openings.
3) Provide mounting lugs to mount the switch.
4) Provide taper tapped hubs with integral bushings for attaching conduit in a through feed arrangement.
b. Materials:
1) Body: Copper free aluminum.
2) Cover: Copper free aluminum.
3) Interior Parts: Sheet steel.
c. Provide a permanent label with the manufacturer's switch type, catalog number, and horsepower rating on the enclosure.
3. Switch Mechanism:
a. For motor circuit switches, provide un-fused, visible blade switches.
b. For disconnect switches, provide switches that at a minimum meet the requirements specified.
c. Provide a stainless steel threaded type operating shaft and stainless steel shaft bushings for each switch.
d. Provide an operating handle with the capability to be padlocked in the “ON” and the “OFF” positions.
4. Finish:
a. Electrodeposit a powered epoxy paint coating onto copper free aluminum items, and then bake this finish sufficiently to fuse the powder coating.
5. Acceptable Manufacturers:
a. Cooper Crouse Hinds; FLS Series.
b. Russell Stoll.
c. Appleton Electric Company.
d. Or Approved Equal.

C. Fuses:
1. Provide current limiting type fuses rated for the voltage and amperage as indicated on the Contract Drawings for those low-voltage switches requiring fuses.
a. For non-motor loads, provide UL Class RK1 single element, fast-acting type fuses.
b. For motor, welder, and transformer loads, provide UL Class RK5 dual element, time-delay type fuses.
2. Acceptable Manufacturers:
a. Cooper Bussman
1) UL Class RK1: Limitron®.

2) UL Class RK5: Fusetron®.
b. Gould-Shawmut.
c. Or Approved Equal.

2.3 SOURCE QUALITY CONTROL

A. Testing Agency/Quality Verification:
1. Perform the standard low-voltage enclosed switch factory tests specified in NEMA KS l and UL 98.
2. Submit evidence of testing agency/quality verification, listing, and labeling for each product with the submitted product data either by providing a printed mark on the data or by attaching a separate listing card.
a. For items without such evidence, provide a written statement from the product manufacturer that indicates why it does not have quality assurance verification.
b. Such statements are subject to the approval of the Engineer.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Install the work of this Section only under the supervision of licensed electricians.

3.2 PREPARATION

A. Provide a prime and finish coat of paint for painted surfaces that will be covered by items provided under this Section.

B. Prior to painting operations, mask all nameplates, plastic parts, push buttons, operating shafts, and other items not to be painted.

C. Ensure that all indoor areas to receive the items provided under this Section are enclosed from the weather.

3.3 INSTALLATION

A. Install disconnect switches and hazardous location switches in accordance with the switch manufacturer's instructions.
1. Mount enclosures on 1/4-inch (6mm) spacers or U-channel supports to provide a space between enclosures and mounting surfaces.
a. Provide supports as specified in Section 26 05 28, Hangers and Supports for Electrical Systems.
2. Set the top of enclosures 6'-6" above the finished floor or grade unless otherwise indicated or specified.

B. Install the switch's conduit and wiring:
1. Punch holes in the disconnect switch enclosures for conduit entries, except use the pre-tapped hubs and integral bushings for attaching conduit to hazardous location switch enclosures.

a. Connect conduit to disconnect switch enclosures with water-tight hubs except as follows:
   1) In dry locations, either the watertight hubs or two locknuts and bushings may be used to connect conduits to the disconnect switch enclosure.
   2) In damp locations, either the watertight hubs or a sealing locknut, interior locknut, and grounding bushing may be used on the bottom of the enclosures.
b. In wet and/or hazardous areas, install a conduit drain-fitting in a hole punched in the bottom of the enclosure, and install a conduit breather fitting in a hole punched in the top of the enclosure.

2. Remove or protect components installed in the interior of enclosures during wire pulling.
3. Use lugs provided by or approved by the disconnect switch manufacturer to connect wiring to the disconnect switch's line and load terminals in conformance with Section 26 05 19, Low Voltage Electrical Power Conductors and Cables.

C. Identify low-voltage enclosed switches in accordance with Section 26 05 53, Identification for Electrical Systems.

3.4 FIELD QUALITY CONTROL

A. Site Testing:
1. Prior to energizing the low-voltage enclosed switches:
   a. Perform insulation testing and ensure that all load-side wiring is clear of shorts in accordance with the requirements of Section 26 05 53, Acceptance Testing for Electrical Systems.
2. Final testing after energizing the circuit breakers:
   a. Perform the thermographic test in conformity with Section 26 05 53, Acceptance Testing for Electrical Systems, and record the circuit parameters.

3.5 PROTECTION

A. Protect the items provided under this Section during the performance of work provided under other Sections, especially during welding and cutting operations.

B. Protect the low-voltage enclosed switches against overloads, short-circuits, and improper operation.
1. Pad-lock the low-voltage enclosed switches in the off position when work is being done on downstream circuits.

END OF SECTION

SECTION 26 28 16.19 - LOW VOLTAGE ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for furnishing, installing, connecting, energizing, testing, cleaning, and protecting enclosed, low-voltage, individually mounted molded-case circuit breakers.

B. Related Sections:
   1. Section 26 05 28 - Hangers and Supports for Electrical Systems.
   2. Section 26 05 53 - Identification for Electrical Systems.
   3. Section 26 05 63 - Acceptance Testing for Electrical Systems.
   4. Section 26 05 19 - Low Voltage Electrical Power Conductors and Cables.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM B 258, Standard Specification for Standard Nominal Diameters and Cross- Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors.

B. National Electrical Manufacturers Association (NEMA):
   1. NEMA 250; Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA AB 1; Molded-Case Circuit Breakers, Molded Case Switches, and Circuit- Breaker Enclosures.

C. National Fire Protection Association (NFPA):
   1. NFPA 70; National Electrical Code (NEC).

D. Underwriter's Laboratories, Inc. (UL):
   1. UL 489; Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit- Breaker Enclosures.

1.3 DEFINITIONS

A. AIC: An acronym for ampere interrupting capacity.

B. AWG: An acronym for American Wire Gage, which is a standard system of designating electrical wire sizes specified in ASTM B 258.

1.4 DESIGN REQUIREMENTS

A. Design molded-case circuit breakers in conformance with the requirements of both NEMA AB 1 and UL 489.

1.5 SUBMITTALS

A. Submit the following information for approval in accordance with the requirements of Section 01 33 00, Submittal Procedures:
   1. Product Data:
      a. Enclosed molded-case circuit breakers
      b. Circuit breaker enclosures
   2. Shop Drawings:
      a. Enclosed molded-case circuit breakers
   3. Quality Assurance/Control Submittals:
      a. Certificates:
         1) Testing agency/quality verification listing cards, if required
         2) Manufacturers written statement indicating why items do not have quality assurance verification, if required
      b. Manufacturer's instructions:
         1) Enclosed circuit breakers

1.6 SHORT CIRCUIT, ARC-FLASH, PROTECTIVE DEVICE COORDINATION AND HARMONIC DISTORTION STUDY

A. The computerized short-circuit, arc-flash, protective coordination and harmonic study will be performed and submitted as outlined in Section 26 05 00 of these specifications.

B. The Contractor is responsible for supplying the necessary and required information in order that this study may be completed and submitted at least two full calendar weeks prior to submitting Shop Drawings for equipment included the respective studies, submit the preliminary studies and corresponding computer printouts and annotated one-line distribution diagram to the Engineer for review and comment.

1.7 QUALITY ASSURANCE

A. Qualifications:
   1. Employ licensed electricians to supervise installation of the work of this Section.

B. Regulatory Requirements:
   1. Conform all work to NFPA 70, the National Electrical Code.

C. Certifications:
   1. Provide products that are either listed and labeled by Underwriters Laboratory, approved by factory mutual, or certified as meeting the standards of UL by the Electrical Testing Laboratory (ETL) for the location installed in, and the application intended, unless products meeting the requirements of these testing laboratories are not available or unless standards do not exist for the products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Use of Trade Names:
1. The use of trade names within the Contract Documents is intended to establish the basis of design and to illustrate the constructability and level of quality required.
2. The use of trade names is not intended to exclude other manufacturers whose products are equivalent to those named, subject to compliance with Contract requirements.

B. Provide circuit-breaker enclosures from the same manufacturer as the circuit-breaker.

C. Acceptable Manufacturers:
1. Manufacturers offering products which can meet the requirements of this Section include, but are not limited to, the following:
   a. Square D Company
   b. Eaton Electric
   c. General Electric
   d. Siemens Industry for LV Power Distribution
   e. Or Approved Equal

2.2 MANUFACTURED UNITS

A. Enclosed Molded-Case Circuit-Breakers:
1. Provide quick make-quick break, unit type molded-case circuit breakers with a thermal magnetic overload trip and lugs on both ends.
   a. Equip the circuit breakers with mechanically trip-free toggle handles.
   b. Equip multiple pole breakers with an internal common trip.
   c. Provide 15 and 20 ampere circuit breakers with lugs capable of accommodating one wire between 14 AWG and 10 AWG.
2. Provide circuit breakers with the Voltage rating, poles, trip setting, and UL listed AIC rating as indicated on the Contract Drawings.
3. Provide factory-installed accessories as indicated and specified.

B. Enclosures:
1. Provide enclosures conforming to the requirements of NEMA 250, type 1.
   a. Provide enclosures of the type indicated or scheduled on the Contract Drawings.
   b. Unless otherwise indicated or scheduled, provide surface-mounted enclosures.
2. Provide enclosures sized to contain the circuit breaker and all other required items.
   a. Provide an interlock that prevents opening the enclosure door when the circuit breaker is in the “ON” position.
      1) Provide an interlock defeater, which requires a common hand-tool to operate.
   b. Provide a copper ground-bus or ground-stud rated for 100 percent of the circuit breaker’s capacity.
3. Provide each enclosure with an external operator that positively indicates the “ON”, “OFF”, and “TRIPPED” positions of the enclosed circuit breaker.
4. Provide the capability to pad-lock the circuit breaker in the “ON” and the “OFF” positions by using three padlocks.

5. If the circuit-breaker is connected to a system with a grounded neutral, provide a copper solid-neutral bus or terminal-lug with a 100 percent rating, and suitable lugs for all incoming and outgoing cables.

2.3 SOURCE QUALITY CONTROL

A. Testing Agency/Quality Verification:
   1. Perform the standard circuit breaker factory tests specified in NEMA AB 1 and UL 489.
   2. Submit evidence of testing agency/quality verification, listing, and labeling for each product with the submitted product data either by providing a printed mark on the data or by attaching a separate listing card.
      a. For items without such evidence, provide a written statement from the product manufacturer that indicates why it does not have quality assurance verification.
      b. Such statements are subject to the approval of the Engineer.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Install the work of this Section only under the supervision of licensed electricians.

3.2 PREPARATION

A. Provide a prime and finish coat of paint for painted surfaces that will be covered by items provided under this Section.

B. Prior to painting operations, mask all nameplates, plastic parts, operating shafts, and other items not to be painted.

C. Ensure that all indoor areas to receive the items provided under this Section are enclosed from the weather.

3.3 INSTALLATION

A. Install circuit breakers in accordance with the circuit breaker manufacturer's instructions.
   1. Mount enclosures on 1/4-inch (6mm) spacers or U-channel supports to provide a space between enclosures and mounting surfaces.
      a. Provide supports as specified in Section 26 05 28, Hangers and Supports.
   2. Set the top of enclosures 6'-6" above the finished floor or grade unless otherwise indicated or specified.

B. Install circuit breaker conduit and wiring:
   1. Punch holes in the enclosures for conduit entries.
   2. In dry locations, two locknuts and bushings may be used to connect conduits to the circuit breaker enclosure.
   3. In damp locations and on the bottom of enclosures, connect conduits to the circuit breaker enclosure with watertight hubs or a sealing locknut.

4. Except in dry areas, install a conduit drain-fitting in a hole punched in the bottom of the enclosure, and install a conduit breather fitting in the top of the enclosure.
5. Remove or protect components installed in the interior of enclosures during wire pulling.
6. Use lugs provided or approved by the circuit breaker manufacturer to connect wiring to the circuit breaker's line and load terminals in conformance with Section 26 05 19, Low Voltage Electrical Power Conductors and Cables.

C. Identify circuit breakers in accordance with Section 26 05 63, Acceptance Testing for Electrical Systems.

3.4 FIELD QUALITY CONTROL

A. Site Testing:
1. Prior to energizing the circuit breakers:
   a. Perform insulation testing and ensure that all load-side wiring is clear of shorts in accordance with the requirements of Section 26 05 63, Acceptance Testing for Electrical Systems.
   b. Set and adjust overcurrent protective devices in conformance with the requirements of Section 26 05 63, Acceptance Testing for Electrical Systems.
   c. Open all downstream disconnects and the circuit breaker.
2. Final testing after energizing the circuit breakers:
   a. Perform the thermographic test in conformity with Section 26 05 63, Acceptance Testing for Electrical Systems, and record the circuit parameters.

3.5 PROTECTION

A. Protect the items provided under this Section during the performance of work provided under other Sections, especially during welding and cutting operations.

B. Protect circuit breakers against overloads, short-circuits, and improper operation.
1. Pad-lock the circuit breakers in the off position when work is being done on downstream circuits.

END OF SECTION

SECTION 26 43 13 - SURGE PROTECTIVE DEVICES (SPD)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: The work specified in this Section consists of materials for furnishing, installing, connecting, energizing, testing, cleaning and protecting enclosed surge protective devices.

B. Related Sections:
1. Section 26 05 00 – Common Work Results for Electrical
2. Section 26 05 26 - Grounding and Bonding
3. Section 26 05 28 - Hangers and Supports for Electrical Systems
4. Section 26 05 63 - Acceptance Testing for Electrical Systems
5. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables
6. Section 26 05 33.13 - Conduit for Electrical Systems

1.2 REFERENCES

A. American National Standards Institute/Underwriters Laboratories (ANSI/UL):
1. ANSI/UL 1449 Surge Protective Devices (Third Edition)
2. UL 1283 Electromagnetic Interference Filters

B. National Fire Protection Association (NFPA):
1. NFPA 70 National Electrical Code (NEC) Article 285.

C. Institute of Electrical and Electronic Engineers/American National Standards Institute (IEEE/ANSI):
1. ANSI/IEEE C62.41.1-2002 IEEE Guide on the Surge Environment in Low Voltage (1000 V and Less) AC Power Circuits
2. ANSI/IEEE C62.41.2-2002 IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
3. ANSI/IEEE C62.41.2-2002 IEEE Recommended Practice on Surge Testing Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.

1.3 SUBMITTALS

A. Make all submittals in accordance with Section 26 05 00.

B. Testing Agency/Quality Verification: Provide with all product data evidence of testing agency/quality verification, listing, and labeling either by printed mark on the data or by a separate listing card. Provide from product manufacturers a written statement indicating why an item does not have a quality assurance verification. Such statements are subject to the approval of the Owner and the Engineer.

C. Product Data and Catalog Cuts: Provide product data within 60 days of contract award for all products provided.

D. Shop Drawings: Submit shop drawings for all Surge Protective Devices.

E. Provide manufacturer's instructions for all Surge Protective Devices.

F. Project Record Documents: Record actual installed elevation and locations of equipment and wiring on record contract and shop drawings as specified in Section 26 05 00.

G. Project Closeout: Include record drawings, shop drawings and product data with Installation and Maintenance Manuals and submit at project closeout in accordance with Section 26 05 00.

1.4 SHORT CIRCUIT, ARC-FLASH, PROTECTIVE DEVICE COORDINATION AND HARMONIC DISTORTION STUDY

A. The computerized short-circuit, arc-flash, protective coordination and harmonic study will be performed and submitted as outlined in Section 26 05 00 of these specifications.

B. The Contractor is responsible for supplying the necessary and required information in order that this study may be completed and submitted at least two full calendar weeks prior to submitting Shop Drawings for equipment included the respective studies, submit the preliminary studies and corresponding computer printouts and annotated one-line distribution diagram to the Engineer for review and comment.

1.5 QUALITY ASSURANCE

A. Conform all quality control work to Section 26 05 00.

B. Provide products that are listed and labeled by Underwriters Laboratory, approved by Factory Mutual or certified as meeting the standards of United Laboratories by the Electrical Testing Laboratory for the location installed in and the application intended unless products meeting the requirements of these testing laboratories are not available or unless standards do not exist for the products.

C. Unless products meeting the requirements of nationally recognized testing laboratories are not readily available for a category of products, provide products that are:
   1. Listed and labeled by Underwriters Laboratory.
   2. Approved by Factory Mutual.
   3. Certified as meeting the standards of Underwriters Laboratory by the Electrical Testing Laboratory.

D. Conform all work to regulatory requirements of all state, local, and national governing codes and requirements, NFPA 70, National Electrical Code, and the requirements of Section 26 05 00.

E. Installer Qualifications: Firm specializing in installing work of this Section with minimum three years documented experience.

F. Install work by or under supervision of licensed electricians.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protect items from damage during delivery, storage and handling in accordance with Section 26 05 00 and as detailed below.

B. Store all products indoors in heated warehouses on blocking or pallets.

1.7 WARRANTY

A. SPD shall have a ten-year warranty. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

PART 2 - PRODUCTS

2.1 SURGE PROTECTIVE DEVICES EQUIPMENT

A. General Requirements:
1. Provide only products satisfying the applicable requirements for testing and reporting as established herein. Devices proposed for use on this project shall be tested in accordance with ANSI/UL 1449 Third Edition, as prescribed by ANSI/IEEE C62.45 - 2002. The voltage protection rating (VPR) or "clamping" voltages shall be recorded for all applicable mode of operation and for each of the test standard waveforms referenced. The results of these tests shall be submitted to the Engineer with the product data sheets as outlined under in this Section.
2. Products furnished for use on this project are to incorporate protective elements in all applicable modes, unless specifically indicated otherwise.
3. Install SPD equipment where so indicated on the Drawings. Voltage class and type of unit to be compatible with distribution voltage being protected.

2.2 Integral Surge Protective Devices:
1. SPD shall be Listed in accordance with ANSI/UL 1449 Third Edition, Standard for Safety, Surge Protective Devices.
2. All SPDs installed on the line side of the service entrance disconnect shall be a Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be a Type 1 or 2 SPD.
3. SPD shall be modular in design. Each protection element shall be a user replaceable surge current diversion Thermally Protected unimodule (MOV based). Each surge current diversion module shall have a short circuit current rating (SCCR) of 200 kA.. Each surge current diversion module shall include solid state status indicator lights.
4. SPD shall provide redundant surge current diversion modules for each mode of Protection. Modes of Protection shall be L-N, L-G, N-G in WYE systems, and L- L, L-G in DELTA systems.
5. SPD shall incorporate copper bus bars for the surge current path. Small gauge round wiring or plug-in connections shall not be used in the path for surge current diversion. Surge current diversion modules shall use bolted connections to the bus bars for reliable low impedance connections.

6. Nominal Discharge Current (In) – SPD applied to the distribution system shall have a minimum 20kA.
7. 320kA and 250 kA SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41.2 - 2002 Category C (Type 1) environments.
8. SPD shall meet or exceed the following criteria:
   a. Minimum surge current rating per mode shall be:
      1) L-N 120 kA
      2) L-G 120 kA
      3) N-G 120 kA
      4) Per phase 250 kA
9. Not used.
10. Not used.
11. SPD shall be equipped with onboard visual LED lights and audible diagnostic monitoring. Red and green LED indicator lights shall provide full time visual diagnostic monitoring of the operational status of each phase as well as each surge current diversion module. Audible diagnostic monitoring shall be by way of audible alarm. This alarm shall activate upon a fault condition. An alarm on/off switch shall be provided to silence the alarm. An alarm push to test switch shall be provided. The diagnostic monitoring circuits shall continually monitor the operational status of the surge current diversion modules. No other test equipment shall be required for SPD monitoring or testing before or after installation.
12. SPD shall be connected to the power bus through a dedicated circuit breaker or disconnect.
13. SPD shall include Form C dry contacts to monitor the performance of each phase and provide a summary alarm.
14. SPD shall include an event surge counter. The counter shall be equipped with a manual reset and a battery or flash memory to retain memory upon loss of AC power. The surge counter display and reset switch shall be mounted on the front of the SPD enclosure.
15. Acceptable Manufacturers:
   a. Eaton Electric
   b. Square D Company.
   c. General Electric.
   d. Siemens Industry for LV Power Distribution.
   e. Advanced Protection Technologies Inc.
   f. LEA International
   g. Or Approved Equal.

2.3 MATERIALS

A. Grounding Materials: Conform to Section 26 05 26

B. Steel Supports and Anchors: Conform to Section 26 05 28

C. Wiring, External to Equipment and Connectors: Conform to Section 26 05 19

D. Conduit Materials: Conform to Section 26 05 33.13

PART 3 - EXECUTION

3.1 PREPARATION

A. Painted surfaces, which will be covered by items of this Section, shall have a prime and finish coat of paint.

B. Ensure that all indoor areas are enclosed from the weather.

3.2 INSTALLATION

A. Space enclosures out from surfaces mounted on 1/4-inch spacers or u-channel supports. Provide supports as specified in Section 26 05 28.

B. Install all Surge Protective Devices in accordance with the manufacturer's instructions.

C. Ground all Surge Protective Devices in accordance with Section 26 05 26, and the manufacturer's instructions using wire as specified in Section 26 05 19, of size No. 6 AWG or larger if otherwise indicated, recommended, or specified.

D. Connect all Surge Protective Devices in accordance with Section 26 05 19 and the manufacturer's instructions. For service, Surge Protective Devices use No. 4 AWG or larger if otherwise indicated or recommended. For branch circuit Surge Protective Devices use No. 6 AWG or larger if otherwise indicated on the drawings, recommended, or specified. For instrument, communication, and data and telephone unit protectors use wire sized the same as the circuit, data-line that the Surge Protective Devices is connected to or larger if otherwise indicated, recommended, or specified.

E. Install all SPD's with the straightest & shortest practical lead length, less than 24 inches.

F. Interface with other work:
   1. Connect conduits to enclosure with watertight hubs except in damp locations on the bottom of enclosures. A sealing locknut may be used in place of watertight hubs and in dry locations two locknuts and bushings may be used.
   2. Connect wiring to line and load terminals with lugs provided or approved by manufacturer in conformance with Section 26 05 19. Remove interior or protect interior components during wire pulling.
   3. Connect to conduit systems in conformance with Section 26 05 33.13.
   4. Connect to wiring systems in conformance with Section 26 05 19.

3.3 FIELD QUALITY CONTROL

A. Site Testing:
   1. Prior to energizing:
      a. Have insulation testing and setting made in conformance of Section 26 05 63.
      b. Ensure that all load-side wiring is clear of shorts and has received and passed the insulation tests of Section 26 05 63.
      c. Energize in presence of Owner and close circuit breaker for first time in presence of Owner.

d. Final testing after energizing:
   1) Perform thermographic test and record circuit parameters in conformity with Section 26 05 63.

3.4 PROTECTION

A. During painting mask all nameplates, all plastic parts, pushbuttons, operating shafts and all items not to be painted.

B. Protect all items during work of other trades including welding and cutting.

C. Protect Surge Protective Devices against short circuits and improper operation.

END OF SECTION

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for general and emergency egress lighting equipment, components, and related installation.

B. Related Sections:
   1. Division 1 Sections
   2. Section 26 05 26 - Grounding and Bonding.
   3. Section 26 05 28 - Hangers and Supports for Electrical Systems.
   4. Section 26 05 63 - Acceptance Testing for Electrical Systems.
   5. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables.
   6. Section 26 05 33.13 - Conduit for Electrical Systems.
   7. Section 26 05 36 - Cable Trays for Electrical Systems.
   8. Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

A. The Aluminum Association, Inc. (AA):
   1. DAF-45, Designation System for Aluminum Finishes.

B. American National Standards Institute (ANSI).
   1. ANSI C81.64, Guidelines and General Information for Electrical Lamp Bases, Lampholders and Gauges.
   2. ANSI C81.64a, Electric Lamp Bases and Holders - Guidelines and General Information for Electrical Lamp Bases, Lampholders and Gauges.
   3. ANSI C82.1, Specifications for Fluorescent Lamp Ballasts.
   4. ANSI C82.1d, Electric Lamps – Paragraphs 5.3.3 and 5.5.3: Compact Fluorescent Lamp Ballasts.
   5. ANSI C82.1e, Fluorescent Lamps – Specifications for Fluorescent Lamp Ballasts.
   6. ANSI C82.2, Fluorescent Lamp Ballasts, Methods of Measurement of.
   7. ANSI C82.2a, Fluorescent Lamps - Methods of Measurement.
   8. ANSI C82.3, Fluorescent Lamp Reference Ballasts, Specifications for.
   9. ANSI C82.4, Ballasts - for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).
   10. ANSI C82.5, Reference Ballasts - High-Intensity-Discharge and Low-Pressure Sodium Lamps.
   11. ANSI C82.6, Reference Ballasts for High-Intensity-Discharge Lamps – Methods of Measurement.
   12. ANSI C82.6a, Reference Ballasts for High-Intensity-Discharge Lamps – Methods of Measurement.
   13. ANSI C82.8, Lamp Transformers – Incandescent Filament Lamp Transformers - Constant Current (Series) Supply Type.

14. ANSI C82.9, High-Intensity-Discharge and Low-Pressure Sodium Lamps, Ballasts and Transformers - Definitions.
15. ANSI C82.9b, Electric Lamp Ballasts - High-Intensity-Discharge and Low- Pressure Sodium Lamps, Ballasts and Transformers - Definitions.
16. ANSI C82.11, High-Frequency Fluorescent Lamp Ballasts.
17. ANSI C82.11a, Lamp Ballasts - Specifications for High-Frequency Fluorescent Lamp Ballasts - Distance to Grounded Starting Aid.
18. ANSI C82.11b, Lamp Ballasts - Specifications for High-Frequency Fluorescent Lamp Ballasts - Line Transient Requirements.
19. ANSI C82.11c, Normative Annex A: Specifications for Low Voltage Control Interface for Controllable Ballasts and Informative Index B: Specification for Nomenclature for Controllable Ballasts.
20. ANSI C82.12, Lamp Ballasts - Ballasted Adaptors.
21. ANSI C82.13, Fluorescent Lamps and Ballasts - Definitions.
22. ANSI C82.77, Lamp Ballasts - Harmonic Emission Limits - Related Power Quality Requirements for Lighting Equipment.

C. Federal Communications Commission (FCC)
1. FCC 47 CFR Part 15, Federal Code of Regulation (CFR) Testing Standard for Electronic Equipment

D. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
1. IEEE C62.41; Recommended Practice on Characterization of Surges in Low- Voltage (1000 V and Less) AC Power Circuits.

E. Illuminating Society of North America (IESNA)
1. IESNA LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products
2. IESNA LM-80, Approved Method for Measuring Lumen Maintenance of LED Lighting Sources
3. IESNA TM-15, Luminaire Classification System for Outdoor Luminaires.

F. National Electrical Manufacturers Association (NEMA):
1. NEMA 250, Enclosures for Electrical Equipment.
2. NEMA SSL 3, High Power White LED Binning for General Illumination

G. National Fire Protection Association (NFPA):
1. NFPA 70, National Electrical Code (NEC).

H. Underwriter's Laboratories, Inc. (UL):
1. UL 496, Standard for Safety of Edison-Base Lampholders.
2. UL 542, Standard for Safety of Lampholders, Starters, and Starter Holders for Fluorescent Lamps
3. UL 924, Standard for Safety of Emergency Lighting and Power Equipment.
4. UL 935, Standard for Safety of Fluorescent Lamp Ballasts.
5. UL 1029, Standard for Safety of High-Intensity-Discharge Lamp Ballasts.
6. UL 1574, Standard for Safety of Track Lighting Systems.
7. UL 1598, Standard for Safety of Luminaires.
8. UL 1598B, Standard for Luminaire Reflector Kits for Installation on Previously Installed Fluorescent Luminaires.
9. UL 1993, Standard for Safety of Self-Ballasted Lamps and Lamp Adapters.
10. UL 1994, Standard for Safety of Low Level Path marking and Lighting Systems
11. UL 2108, Standard of Safety of Low Voltage Lighting Systems.

I. U. S. Government:
1. Occupational Safety and Health Administration (OSHA):
a. 29 CFR 1910 Occupational Health and Safety Standards.
b. 29 CFR 1926 Safety and Health Regulations for Construction.
2. Federal Communications Commission (FCC):
a. 47 CFR 18 Industrial, Scientific, and Medical Equipment.
3. Department of Energy (DOE):
a. The Energy Policy of 2005, Public Law 109-58.

1.3 DEFINITIONS

A. LED – An acronym for "Light-Emitting Diode" used to indicate a semiconductor light source.

1.4 DESIGN REQUIREMENTS

A. Design Criteria:
1. The Lighting Fixture Schedule on the Contract Drawings constitutes the basis of the lighting design for this Contract, but may not indicate the special design details required.
a. The Lighting Fixture Schedule includes the lighting fixture descriptions, fixture manufacturers, and corresponding model numbers.
b. The lighting fixtures as scheduled meet the requirements of the lighting design for this Contract with respect to the visible style, number of lamps, and lenses desired.
2. Provide lighting fixtures meeting the requirements of the basis of the lighting design for this Contract, and which have the special details specified in this Section.
a. Submit Shop Drawings and manufacturer's installation instructions to show details of assemblies and sub-assemblies, and specially-fabricated supporting and fastening devices.
b. Submit bills of material for the fixtures and their appurtenances.
1) Reference the bills of material to the Shop Drawings.
2) Provide bills of material consisting of itemized lists of the parts required (i.e. ballast capacitor igniter, and other similar item descriptions).
3) Identify each part with a part number and/or manufacturer number.
c. Provide fixtures for exterior installation that are designed to be completely waterproof.
d. Provide luminaire brackets designed to be compatible with configuration of the luminaire.

B. Prior to providing light fixtures substituted for the fixtures identified in the Lighting Fixture Schedule on the Contract Drawings, submit the following information to obtain the Engineer's approval to substitute the fixtures:
1. The manufacturer's catalog cuts indicating the type, design, dimensions, mounting arrangement, and other industry standard lighting fixture information.
a. Describe the lighting fixtures, exit signs, emergency battery units, and appurtenances.
2. Manufacturer's photometric data, distribution curves, isolux charts, glare factor data, and coefficient of utilization.
3. Complete photometric data for the fixture, including optical performance, completed by an independent testing laboratory developed according to the standards of the Illuminating Engineering Society of North America as follows:
a. For direct, direct/indirect and indirect lights used for general illumination:
1) Coefficients of utilization.

2) Candlepower data, presented graphically and numerically, in 5 degree increments (5 degree, 10 degree, 15 degree, etc.). Data developed for up and down quadrants of normal, parallel, and at 22-1/2 degree, 45 degree, 67-1/2 degree planes to lamp(s). If light output is asymmetric, provide additional planes as required to complete report.
3) Zonal lumens stated numerically in 10 degree increments (5 degree, 15 degree, etc.) as above.
4) Average luminaire luminance calculated in the lengthwise, crosswise, and 45 degree vertical planes.

b. For exterior roadway, area, or floodlighting luminaires, photometric data shall include isocandela charts, coefficient of utilization, IES roadway distribution classification (where applicable), and isofootcandle plots for the specific mounting heights, lamps, and conditions of the project.

4. Point-by-point lighting calculations showing the uniformity of light on the horizontal work plane in areas where substitutions are proposed. The substituted fixture shall be equivalent to the named fixture, including lighting level, Visual Comfort Performance (VCP), glare, Equivalent Sphere Illumination, energy usage and aesthetics.
   a. Prior to executing the point-by-point lighting calculations, request individual light loss factors, as defined in Chapter 9 of the IESNA lighting handbook, from the Engineer for input into the point-by-point lighting calculation.
   b. For each substituted light fixture provide photometric data and related information in IESNA standard file format for electronic transfer on a CD ROM.

C. Submit a complete lamp inventory for approval, including specific lamp type, manufacturer, and all appropriate lamp criteria including but not limited to: life, initial and mean lumens, beam spread, candlepower, lamp envelope, base type, color temperature, and color rendering index.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. The execution of work of this Section must satisfy the applicable requirements of the latest edition of NFPA 70 (NEC), the National Occupational Safety and Health Act as embodied in 29 CFR 1910 and 29 CFR 1926, and regulations of local jurisdictional authorities.
2. Comply with the requirements of the Energy Policy Act (EPACT) of 2005 and the applicable version of the International Energy Conservation Code.

B. Certifications:
1. All products must be Underwriters' Laboratories (UL) listed; and each fixture, Emergency Battery Unit, and exit sign must bear the UL label.
   a. The UL standards appropriate for the products specified are listed in Paragraph 1.02.E.
2. Fixtures that are to be installed in areas subject to the weather must be UL listed as "Enclosed and gasketed suitable for wet locations".
3. Provide lighting fixture ballasts certified by the Certified Ballast Manufacturers Association (CBM) or its successor organization to be in accordance with standard ballast specifications established by ANSI as listed in Paragraph 1.02.A.

1.6 SUBMITTALS

A. Submit the following information for approval in accordance with the requirements of Section 01 33 00, Submittal Procedures:
   1. Product Data:
      a. Manufacturer's catalog cuts.
         1) Lighting fixtures catalog cuts
         2) Ballast catalog cuts that include specific ballast information with sufficient information to show compliance with Contract Documents.
         3) Lamp catalog sheets of each lamp type for approval, including specific lamp type, manufacturer, and all appropriate lamp criteria including but not limited to: life, initial and mean lumens, beam spread, candlepower, lamp envelope, base type, color temperature, and color rendering index
      b. Manufacturer's photometric data, distribution curves, isolux charts, glare factor data, and coefficients of utilization for each lighting fixture type.
   2. Shop Drawings:
      a. Shop Drawings.
      b. Bills of material.
   3. Quality Assurance/Quality Control Submittals:
      a. Design Data:
         1) Calculations demonstrating that substituted fixtures are equivalent to the named fixtures.
      b. Certificates:
         1) Proof that equipment furnished has the required Underwriters' Laboratories (UL) listing.
         2) Ballast certifications.
      c. Manufacturer's Instructions:
         1) Manufacturer's installation instructions.

1.7 EXTRA MATERIALS

A. Lamps:
   1. For the lighting fixtures furnished, provide an additional 10 percent of each lamp type specified over the quantity required to initially lamp the fixtures furnished.

B. Maintenance Tools:
   1. Provide two each of the special maintenance tools as may be necessary for re- lamping fixtures and for fixture maintenance.

C. As the equipment for which the extra materials can be used is substantially completed, turn the extra materials for that equipment over to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduit and Raceway:
   1. Provide electrical conduit and raceway in accordance with the requirements of Section 26 05 33.13, or as indicated and as appropriate for the application per NFPA 70.

B. Control Devices:
   1. Provide electrical lighting control devices in accordance with the requirements of Section 26 27 26.

C. Fixture Support Devices and Fasteners:
   1. In addition to the supporting devices and fasteners specified in Section 26 05 28, provide suspension accessories, canopies, casing, sockets, holders, reflectors, plaster frames, recessing boxes, and similar items required to support the lighting equipment and luminaries as specified or indicated.

D. Wire and Cable:
   1. Provide electrical wire and cable in accordance with the requirements of Section 26 05 19.

2.2 MANUFACTURED UNITS

A. Light Fixtures:
   1. Provide those fixtures indicated on the Lighting Fixture Schedule on the Contract Drawings or approved substitutions.
      a. The manufacturers' fixture descriptions and corresponding fixture model numbers are also listed in the Lighting Fixture Schedule on drawing E-001.
      b. Additional manufacturers who can provide products comparable to those provided by the manufacturers listed and whose products the Contractor proposes to use for this Contract must first be submitted to and receive the approval of the Engineer prior to being substituted for the listed manufacturers.
   2. Fixture Grounding Device and Conductor:
      a. Provide the housing of each fixture with a separate, factory-installed grounding device and ground conductor.
   3. Exterior Fixtures:
      a. Factory-equip fixtures intended for exterior installation with waterproof gaskets and anodized aluminum frames unless indicated otherwise on the Contract Drawings.
         1) Provide outlet boxes, neoprene gaskets, and stainless steel hardware to render the exterior fixture installation waterproof.
      b. Finish:
         1) Provide fixtures for exterior installation with a finish free of scratches and other surface blemishes.
      c. Brackets:
         1) Provide brackets of the type and style indicated or scheduled on the Contract Drawings and color matched to the light fixture.

B. LED Lighting Fixtures (excluding LED exit signs)
   1. Color temperature of any substituted fixture shall be within 10% of the specified value shown on the drawings.
   2. Power consumption of any substituted fixture shall not exceed the specified value shown on the drawings by more than 10%. If a substituted fixture is submitted and approved at an increased wattage 9within 10% of the specified wattage), any power system modifications necessary to accommodate the fixtures will be the responsibility of the Contractor (i.e. increased wire sizes, increased circuit breaker size, additional circuits/breakers, etc.)
   3. LED Lumen Efficacy (Lumens/Watt) of a substituted fixture shall not be less than the specified fixture by more than 10%.

4. Characteristics of substituted fixtures shall have the same features as the specified LED fixtures (i.e. redundant drivers, driver protection, etc.) whether specifically noted on the lighting fixture schedule or not.
5. Drivers shall not exceed 350mA unless specifically noted otherwise on the lighting fixture schedule. Drivers shall have a Class A sound rating.
6. LED Light fixtures shall have a minimum expected life of 50,000 hours. The aforementioned life rating must be conducted with a 40 degrees calcium ambient temperature.
7. Power Factor: The LED fixture shall have a power factor of 0.90 or greater.
8. Total Harmonic Distortion induced into the AC power line by the luminaire shall not exceed 20 percent.
9. Surge Suppression: The LED fixture on-board circuitry shall include surge protective devices to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD shall protect the luminaire from damage and failure for common mode transient peak voltages up to 10 kV (minimum) and transient peak currents up to 5 kA (minimum). SPD shall conform to UL 1449 depending of the components used in the design. SPD performance shall be tested per the procedures in ANSI/IEEE C62.41-1992 (or current edition) for category A (standard). The SPD shall fail in such a way as the Luminaire will no longer operate. The SPD shall be field replaceable.
10. Operational Performance: the LED circuitry shall prevent visible flicker.
11. Thermal Management: The thermal management (of the heat generated by the LED's) shall be of sufficient capacity to assure the proper operation of the luminaire over the expected useful life. Thermal management shall be by passive design – the use of fans or other mechanical devised is not allowed.

C. Lighting Contactors:
1. Provide the type of contactor scheduled on the Contract Drawings, with the number of poles per contactor and the amperage and load voltage ratings indicated.
   a. For all types of lamp loads, provide single or multiple contact, continuous duty, electrically or mechanically held type contactors suited for non- inductive loads.
   b. Provide contactors of the flush dead back design with arc shields and barriers to prevent pole-to-pole flashover.
   c. Provide contactors with all parts accessible for inspection and maintenance.
      1) Provide contacts that are readily replaceable from the front of their panels.
2. Interrupting Capacity:
   a. Provide contactors with an interrupting capacity of 150 percent of their rating with no derating for high inrush loads.
3. Enclosure:
   a. Provide a contactor enclosure designed to meet the requirements for NEMA 12 surface type enclosures as specified in NEMA 250 unless indicated otherwise on the Contract Drawings.
   b. Provide enclosures complete, and with provisions for padlocking.
4. Acceptable Manufactures
   a. Square D www.schneider-electric.com
   b. Eaton Electric www.eatonelectric.com
   c. Siemens www.siemens.com
   d. General Electric www.geindustrial.com
   e. Allen-Bradley www.ab.com
   f. Or Approved equal.

D. Photocontrols:

1. Provide cadmium sulphide, hermetically sealed photocells suitable for remote mounting.
    a. For individual luminaries, provide plug-in, twist-to-lock-type photoelectric controls with voltage characteristics compatible with the luminaire.
    b. For a group of luminaires and/or lighting fixtures, provide conduit mounted type photoelectric controls with the voltage characteristics indicated on the Contract Drawings.
2. Provide fully temperature compensated photo controls designed with a 15 second time delay to prevent false switching.
3. Acceptable Manufacturers:
    a. Tork www.torkusa.com
    b. Tyco Electronics www.te.com
    c. Paragon Electrical Products www.paragontimecontrols.com
    d. Or Approved equal.

E. Luminaire Brackets:
1. Provide luminaire brackets of the type and style as indicated or scheduled on the Contract Drawings and color matched to light fixture.
2. Provide luminaire brackets fabricated to be compatible with the configuration of the luminaire.

F. Luminaire Poles
1. Comply with AASHTO LTS-3 for pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.
2. Wind-Load Strength of Total Support Assembly: Adequate to carry support assembly plus luminaires at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of 70 mph with a gust factor of 1.3. Support assembly includes pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.
3. Strength Analysis: For each pole type and luminaire combination, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
4. Aluminum Poles: Fabricated from seamless, extruded structural tube complying with ASTM B 429, 6063-T6 alloy with access handhole in pole wall.
5. Metal Pole Brackets: Match pole metal. Provide cantilever brackets without underbrace, in sizes and styles indicated, with straight tubular end section to accommodate luminaire.
6. Finish: Match finish of pole/support structure for arm, bracket, and tenon mount materials.

G. Luminaire Pole Foundations
1. Pole/Support Structure Bases: Anchor type with hold-down or anchor bolts, leveling nuts, and bolt covers.
2. Embedded type with underground conduit/cable entry.
3. Comply with Specification Section 03 30 00- Cast-in-Place Concrete.
4. Design Strength: 4000-psig (20.7-MPa), 28-day compressive strength.

H. Boxes, Gaskets, Hardware, and Support Devices:
1. Provide outlet boxes, neoprene gaskets, and stainless steel hardware to render the installation of the lighting waterproof.
    a. Provide waterproof splice kits where required as specified in Section 26 05 19.
2. Supply pendant stems, special mounting supports and hardware, and miscellaneous materials and incidentals required to install the lighting and emergency battery unit products in place.

3. Provide neoprene spacers for maintaining clearance between lighting and emergency battery unit products and concrete, mortar, and other masonry surfaces.

2.3 CEILING MOUNT OCCUPANCY SENSORS

A. One Way Directional Occupancy Sensor:
   1. Occupancy sensor shall combine both ultrasonic and passive infrared sensing.
   2. Occupancy sensor shall operate on 24VDC.
   3. Occupancy shall have automatic timer and sensitivity features to prevent “false- offs” and “false ons”.
   4. Occupancy sensor shall cover 1,000 square foot.
   5. Occupancy sensor shall be provided with a mask to eliminate the coverage area for applications not requiring the full field of view of 360 degrees.

B. Multi-Directional Occupancy Sensor:
   1. Occupancy sensor shall combine both ultrasonic and passive infrared sensing.
   2. Occupancy sensor shall operate on 24VDC.
   3. Occupancy shall have automatic timer and sensitivity features to prevent “false- offs” and “false ons”.
   4. Occupancy sensor shall cover 2,000 square foot.
   5. Occupancy sensor shall be provided with a mask to eliminate the coverage area for applications not requiring the full field of view of 360 degrees.

C. Power Pack for Occupancy Sensors:
   1. Power Pack shall have a high impact, UL rated 94 – 5 V plastic construction case.
   2. Power Pack shall be plenum rated.
   3. Power Pack shall have a 277V primary input and a 24 VDC, 100 mA nominal, full-wave rectified and filtered output.
   4. Power Pack shall have two isolated relays for the control of two circuits. Contact ratings shall be 20A for fluorescent ballasts and 1 HP for motor load.

2.4 ENTRANCE DIRECTIONAL LIGHTS

A. Provide directional lights above each traffic lane.

B. The directional lights shall be red and green, LED, 300 mm by 300 mm signal modules.

C. The material requirements, manufacturing, performance tests and electrical components shall be in accordance with NYS DOT Engineering Instructions EL 04-041.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to ordering flush mounted or lay-in type lighting fixtures, verify their locations and clearances, and coordinate with other construction work to verify that the fixtures will fit without interferences.

1. The Engineer assumes no responsibility for clearance, dimensions, tolerances, or exact hanging frame dimensions.

B. Prior to beginning installation of the lighting fixtures and accessories, verify that all other work affecting the installation of the lighting fixtures and accessories is complete to the extent that the light fixtures may be installed over substrates or incorporated into integrated systems without adversely affecting the lighting or other construction.

3.2 INSTALLATION

A. Assemble lighting fixtures if required; and install and wire the lighting fixtures, supports, brackets, and accessories at the locations and mounting heights indicated on the Contract Drawings.
1. Wire the lighting fixtures and accessories as specified in Section 26 05 19.
2. Ground the lighting fixtures in accordance with the requirements of Article 410 of NFPA 70 (NEC) and Section 26 05 26.
   a. Use the fixture grounding device to connect a separate grounding conductor in compliance with requirements specified in Section 26 05 26.
3. Install all photoelectric controls facing north for proper operation.

B. Recessed Fixture Installation:
1. Support recessed fixtures on the ceiling system's structural elements rather than its surface materials such as tiles, plaster, drywall, or similar surfaces.
   a. Use the mounting yokes furnished with the fixtures and, where required, the supports specified in Section 26 05 28.
2. If the fixture is to be installed in modular tile ceilings, locate the fixture in the center of the ceiling panel unless indicated otherwise.
   a. Refer to the Architectural Reflected Ceiling Plan included in the Contract Drawings for modular tile ceiling layouts.
3. If light leaks through gaps between the recessed fixture trim and the adjacent surface, install suitable sealing gaskets.

C. Exposed Fixture Installation:
1. Install surface mounted and exposed fixtures as indicated on the Contract Drawings.
   a. Hang suspended fixtures plumb, with continuous rows of fixtures in alignment.
   b. Mount suspended fixtures in each room or area at the same height regardless of varying clear height conditions unless otherwise indicated on the Contract Drawings.
   c. Install surface mounted fixtures tight up against the substrate to eliminate gaps except where NFPA 70 (NEC) or local code restrictions require a separation between the fixtures and substrate.
2. Exit Fixture Installation:
   a. Install exit fixtures for doors directly over the doorways as indicated on the Contract Drawings
   b. Center the fixtures over the doorways, and install the fixtures to clear the door and associated hardware.

D. Poles
1. Use web fabric slings (not chain or cable) to raise and set poles.
2. Mount pole to foundation with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
3. Secure poles level, plumb, and square.

4. Grout void between pole base and foundation. Use nonshrinking or expanding concrete grout firmly packed in entire void space.
5. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

3.3 INTERFACE WITH OTHER WORK

A. Verify the locations and clearances of other installed or proposed work, and coordinate lighting fixture installations accordingly.

B. Coordinate the installation of lighting fixtures with all building systems and components to avoid any installation conflicts.

3.4 FIELD QUALITY CONTROL

A. Inspect, test, and certify lighting and the associated electrical distribution system and equipment in accordance with the requirements of Section 26 05 63.

3.5 CLEANING

A. Clean new lighting fixtures by following the cleaning procedures as recommended by the fixture manufacturer:
1. Use only those products for cleaning as recommended in the fixture manufacturer's literature.

3.6 AIMING AND FOCUSING

A. Contractor shall notify the owner one week in advance and establish schedule for a night when final aiming will be done.

B. Lock the aiming adjustments, set during final aiming, in position. Position must hold during relamping and normal maintenance.

END OF SECTION

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SECTION 27 00 00 COMMUNICATIONS SYSTEM

PART 1 - GENERAL

1.1 OVERVIEW:

A. The Communications System Work under this Contract consists of, but not necessarily be limited to, furnishing and installing fiber optic and copper communications network interfaces and equipment with associated power supplies, cabinets, wiring and cabling, housing, mounts, brackets, conduits, fitting and connectors at designated network access sites to support communication needs of the systems required under this Contract. Please see Contract Drawings for specific locations requiring work. Locations shall include all field locations under Contract, and all remote and central locations to interface with this Contract for Metro-North Railroad (MNR) station platforms and customer areas.

B. The Communications systems provided shall be fully integrated with the existing MNR Communications Systems.

C. The contractor is responsible for all installations, configurations to final integrations into the MNR Communications Systems.

D. Contractor shall be responsible to ensure that all equipment (to be furnished and installed under Contract) and cabling have the correct connector types and are configured with the correct configuration options.

E. The Contractor shall bear full responsibility for furnishing, removals and installations of equipment required under this Contract. All shop drawings submitted for approval shall be checked, approved and countersigned by a Professional Engineer licensed by the State of New York. Submit drawings showing all cabling and wiring necessary for a functional system such as communications wiring between new equipment and existing equipment / patch panels / termination blocks both inside and outside the cabinet, and wiring for powering of new equipment, the proposed method of installation of chases, rack layouts, brackets, conduit, equipment layouts, and other field requirements. The contractor shall not proceed with such work until approval has been received. Such approval is for the sole responsibility of minimizing delays and rework in the field due to late identification of unacceptable practices and shall not relieve the Contractor of the responsibility for the accuracy, constructability and operational integrity of the Work.

F. Equipment shall be capable of interfacing with, and transporting the following applications:
1. Digital (IP-based) CCTV;
2. Fire alarm system;
3. MEP SCADA system;
4. Wireless data access system (such as IEEE 802.11 and 802.16);
5. Enterprise data system, including employee workstations;
6. Automated fare collection system;
7. Emergency alarm system;

G. Fiber optic and copper connections shall be used for network connections between remote sites and networking equipment in communications rooms. Where applicable and noted under this

Contract, furnish and install media converters to support the connectivity to the communications rooms.

H. All copper and fiber cabling shall be armored or installed in conduits to protect from rodent damage.

I. The Contractor shall follow the guidelines below:
1. Complete all site surveys and network design prior to furnishing any network equipment.
2. Acceptance Testing of the network system shall be performed.
3. Configuration and provisioning of network equipment with appropriate addresses shall be completed prior to installation of equipment in the field.
4. Test all MNR provisioned circuits to ensure circuit parameters meet the need of the Contract.

J. Coordination with Other On-going Contracts
1. Coordinate the work under this Contract with other contracts that are in construction at the sites indicated in Contract Drawings as they have impacts on schedule and successful completion of this Contract.

K. Section Includes:
1. Telecommunications network interfaces.
2. Telecommunications mounting elements.
3. Backboards.
4. Communications equipment racks and cabinets.
5. Power Strips.
6. Grounding.
7. Unshielded twisted pair cabling.
8. Fiber optic cabling.
9. Data and voice outlets.

1.2 DEFINITIONS

A. CCTV: Closed Circuit Television

B. AWG: American Wire Gauge

C. AMP: Ampere

D. ASCE: American Society of Civil Engineering

E. mAMP: Millie Ampere

F. AC: Alternative Current

G. DC: Direct Current

H. V: Voltage

I. EMF: Electromagnetic Frequency

J. COM: Communication

K. CPU: Central Processing Unit

L. FOC: Fiber Optic Cable

M. FOV: Field of View

N. IEEE: Institute of Electrical and Electronic Engineering

O. IP: Internet Protocol

P. RU: Rack Unit

Q. NVR: Network Video Recorder

R. MTA: Metropolitan Transpiration Authority

S. MNR: Metro North Rail-Road

T. NEC: National Electrical Code

U. NFPA: National Fire Protection Association

V. UL: Underwriter Laboratory

W. UTP: Unshielded twisted pair

X. LAN: Local Area Network

Y. VMS: Video Management System

Z. PA: Public Address

AA. PoE: Power over Ethernet

BB. PoE+: Power over Ethernet (Plus)

CC. PB: Pull Box

DD. PDU: Power Distribution Unit

EE. JB: Junction Box

FF. SIA: Security Industry Association

GG. TCP/IP: Transmission Control Protocol/Internet Protocol

HH. TIA: Telecommunications Industry Association

II. UL: Underwriters Laboratory

JJ. NEMA: National Electrical Manufacturer's Association

KK. ANSI: American National Standards Institute

LL. ASTM: American Society for Testing and Materials

MM. ADA: Americans with Disabilities Act

NN. UTP: Unshielded Twisted Pair

OO. WAN: Wide Area Network

PP. IEC: International Electro Technical Commission

QQ. PC: Personal Computer

RR. UPS: Uninterruptible Power Supply

SS. BICSI: Building Industry Consulting Service International

TT. RCDD: Registered Communications Distribution Designer

1.3 CODES AND STANDARDS

A. All items furnished and installed under this Specification shall comply with the latest edition of applicable codes, provisions and all applicable standards issued by the organizations referenced below. The following publications are incorporated herein by reference to the extent applicable:

1. National Fire Protection Association (NFPA):
   a. NFPA 70 National Electrical Code.
2. Underwriters Laboratories, Inc. (UL) Standards
3. National Electrical Manufacturers Association (NEMA) Standards
4. American National Standards Institute (ANSI) Standards
5. Telecommunications Industries Association/ Electronic Industries Alliance (TIA/EIA) standards
6. Leadership in Energy and Environmental Design (LEED)
7. U.S. Green Building Council (USGBC)
8. International Organization for Standardization (ISO)
9. Americans with Disabilities Act (ADA)
10. Building Code of New York State
11. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
12. New York State Electrical Code (NYSEC)
13. Institute of Electrical and Electronics Engineers (IEEE) Standards
14. Advanced Television System Committee (ATSC)
15. Audi Engineering Society (AES)
16. Institute of Electrical and Electronics Engineers (IEEE) Standards
17. Telecommunications Industries Association/ Electronic Industries Association (EIA/TIA) standards.

B. Equipment shall meet all FCC rules and regulations including but not limited to the rules governing lightning and surge protection, electromagnetic interference and electromagnetic compatibility.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Manufacturer's certification as required: signed by the manufacturer certifying that they comply with the specification's requirements. Upon request, submit evidence of experience.
4. Product certification as required: signed by the Contractor, certifying that the installers comply with the specified requirements.
5. Submit catalog cuts for wires and cables. Do not issue purchase orders or order the cable to be manufactured until approval of the catalog cuts.
6. For Public Address System: For the following equipment as may be required under this contract:
   a. Preamplifiers.
   b. Power amplifiers.
   c. Transfer to standby amplifier.
   d. Volume limiter/compressor.
   e. Tone generator.
   f. Equipment cabinet and rack.
   g. Loudspeakers.
   h. Volume Attenuator Station
   i. Battery backup power unit.
7. For CCTV System:
   a. Manufacturer's product data and installation instructions for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including startup instructions. Provide samples as required. Product data shall be clearly labeled providing the reviewer with all relevant information required. These devices, products and materials shall have a product data sheet either previously submitted and approved or be part of the current Submittal.

B. Shop Drawings:

1. For Communications Equipment: Include plans, elevations, sections, details, and attachments to other work.
   a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   b. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.

      1) Provide detailed cabinet layouts indicating equipment and mounting location within the rack.

2) Provide detailed wiring diagram and schematic for the all equipment.
3) Communication Room Drawings indicating:

i. Architectural plan of the room with dimensions, including elevations.
ii. Location of equipment cabinets, racks, cables, cable ladders and conduits with sizes and types.
iii. A.C. and D.C. feeds to equipment cabinets with references to the source locations (electric panels, transfer panels, etc.).
iv. Location of equipment proposed for future installation, as directed.

c. Submit schematic cable connections, wire, conduit and trough schedules, duct assignment, cable entrance details, cable tray, conduit and trough layouts, cable layout and detailed construction drawings for approval before the start of any work. Submit junction box(s) and pull box(s) development drawings indicating existing and new cables before the start of work. The drawings shall also indicate existing and new cable arms and racks.

2. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.
3. Tagging/labeling nomenclature and related product data.
4. For CCTV System:
   a. Submit schematic cable connections, wire, conduit and trough schedules, duct assignment, cable entrance details, cable tray, conduit and trough layouts, cable layout and detailed construction drawings for approval before the start of any work. Submit junction box(s) and pull box(s) development drawings indicating existing and new cables before the start of work. The drawings shall also indicate existing and new cable arms and racks.
   b. Plans indicating location of cameras along with mounting types and FOV. Plans shall clearly label all devices, products and materials that are to be installed. Plans shall also provide a detailed layers layout of the platform, lighting and canopy indicating camera locations indicating wiring and conduits being utilized to interconnect all portions of the VMS system. Layers shall be in PDF and AutoCAD formats allowing the ability of the reviewer to enable and disable layers.
5. For Public Address System: Signed and sealed by a qualified professional engineer.
   a. Equipment Details: Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location of each field connection.
   b. Product data for each product specified; samples as required.
   c. Plans furnished by the manufacturer.
   d. Rack arrangements.
   e. Wiring Diagrams: Power, signal, and control wiring. Include the following:
      1) Identify terminals to facilitate installation, operation, and maintenance.
      2) Single-line diagram showing interconnection of components.
      3) Cabling diagram showing cable routing.

C. As-built Drawings:

1. Final installation drawings of communications System, drawn to scale based on all contractual approved changes from original contract.
2. Show cabling administration-point labeling. Identify labeling convention and show labels for equipment cabinets, power cables, copper communication cables, fiber cables, terminal hardware and positions, and equipment grounding conductors.

3. Furnish (6) six hard copies and an electronic record of all drawings, in software and format selected by the MNR.

D. Cable Schedule:

1. List incoming and outgoing cables and their origins and destinations.
2. Furnish an electronic copy of final comprehensive schedules.

E. Operation and Maintenance Data manuals.

F. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

G. Submittal log.

H. Test procedures and test reports for all testing and product data for test equipment; forms to be used for test data; test schedule; certified copies of test results; notification of testing four weeks in advance.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
2. Bidder must submit their Manufacturing Quality Program Manual (MQPM) and a sample of the proposed product with their bid.
3. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall always be present when Work of this Section is performed at Project site.
4. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection

B. CCTV System:
1. Manufacturer shall be a firm regularly engaged in a manufacture of enterprise grade CCTV System, of types and sizes required, whose products have been a satisfactory use similar service for not less than five years. Products should be compatible with the existing MNR and MTA PD deployed products.
2. Installer is required to document that all technicians are currently certified by the CCTV System manufacturer and shall have a minimum five years successful experience in CCTV System installations.
3. Testing Agency Qualifications: Qualified agency, with the experience and capability to conduct testing indicated. Testing Agency's Field Supervisor: Currently certified by manufacturers to supervise onsite testing.
4. Source Limitations: Obtain CCTV System and/or CCTV System components from a single source and/or a single manufacturer, where applicable.
5. 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.
6. Comply with NFPA 70
7. All components and materials shall be UL listed.

1.6 SYSTEM DESIGN:

A. The system shall follow the current Communications System Design Guidelines and MNR Standards.

B. The system shall contain the latest security methods utilizing industry-standard technologies. The system shall be upgradeable by way of firmware, software, or ROM upgrades as new security technologies are standardized.

C. The system shall be complete with all required hardware and licenses for an ISP to connect and install equipment in the communication cabinet.

PART 2 - PRODUCTS

2.1 COMMUNICATIONS ROOM (WHERE REQUIRED):

A. The room's square footage shall accommodate all required communications and IT equipment, but at a minimum, shall have at least 64 square feet of usable floor space.

B. Four (4) dedicated 20-amp, 120-volt circuits with isolated grounds.

C. Sufficient insulation to prevent wide temperature swings in the conditioned space.

D. Smoke detector wired to station Fire Alarm System if station is occupied with such system.

E. The room shall be equipped with a secured door that can be accessed by IT department staff.

2.2 NETWORK EQUIPMENT (WHERE REQUIRED):

A. The network equipment shall support redundant communications with management system.

B. The network equipment shall be mounted to allow ease of access to front of cabinet.

C. The network equipment shall be mounted to minimize vibration effects on equipment.

D. The network equipment shall be mounted to maximize contiguous free panel space for future use.

E. The network equipment shall support 10GBASE-X LAN PHY and 10GBASE-X WAN PHY modules, with small form pluggable modules of appropriate type for single mode and multi-mode fiber optic cables.

F. The network equipment shall be configured with a power supply. The most appropriate PS shall be provided for this project.

G. Equipment shall be configured for 120VAC power supply.

H. Equipment shall support -48VDC power supply.

I. The network equipment shall support 10/100/1000BASE-T.

J. The network equipment shall support all IEEE 802.XX related protocols, not necessarily limited to 802.3ah, 802.1D, and 802.1ah.

K. The network equipment shall support, not necessarily limited to, IGMP Snooping, DHCP, BOOTP, DHCP relay, NTP, SNTP, STP and RSTP.

L. All communications equipment shall be capable of supporting both local and remote security mechanisms for access. Local security mechanisms shall include any security mechanism to prevent unauthorized access via the craft terminal interface. Remote security mechanisms shall include any security mechanism to prevent unauthorized access via the remote interface.

M. Equipment shall support SR (short reach), IR (intermediate reach), LR (long reach) and VLR (very long reach) optical interfaces.

N. Furnish and install optical interfaces of appropriate transmit power rating (SR, IR, LR or VLR) to support the link attenuation calculations. Contractor shall submit for approval the interfaces to be used for the network system.

O. Equipment shall support 850 nm wavelength transmission for multimode fiber.

P. Equipment shall support 1310 nm wavelength transmission for single mode fiber.

Q. Equipment shall support all Metro Ethernet Forum specifications, not necessarily limited to, MEF-2, MEF-3 and MEF-4.

R. Equipment shall support all ITU-T specifications for connection-oriented Ethernet, not necessarily limited to, G.8032 and G.8032.

S. Equipment shall support Power over Ethernet (POE).

2.3 EQUIPMENT FRAMES, RACKS, CABINETS AND ENCLOSURES (WHERE REQUIRED):

A. Racks shall include all equipment for the systems including, but not limited to the PA system (Audio System), Visual Display System and TVMs/TOMs.

B. IT and C&S departments shall cooperatively determine the location of their equipment in the new Communications Room.

C. Manufacturers: Subject to compliance with requirements, provide products as below or equivalent to:
1. Chatsworth Universal Equipment Rack
2. APX.
3. Belden Inc.
4. Cooper B-Line.
5. Emerson Network Power Connectivity Solutions.
6. Hubbell Premise Wiring.
7. Leviton Commercial Networks Division.
8. Middle Atlantic Products, Inc.
9. Ortronics, Inc.

10. Panduit Corp.
11. Siemen Co.
12. Tyco Electronics Corporation;
13. AMP Products.
14. Rittal.

D. General Frame Requirements:

1. Distribution Frames: Chatsworth Universal Equipment Rack 84” H’ x 19’’W, 45 RMU Standard Equipment Rack, Black Anixter #164164, CPI # 46353-703 or equivalent.
2. Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
3. Module Dimension: Width compatible with EIA 310-D standard, 19-inch (480-mm) panel mounting.
4. Finish: Manufacturer's standard, baked-polyester powder coat.

E. Floor-Mounted Racks: Modular-type, steel construction.

1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
2. Baked-polyester powder coat finish.

F. Modular Freestanding Cabinets:

1. Removable and lockable side panels.
2. Hinged and lockable front and rear doors.
3. Adjustable feet for leveling.
4. Screened ventilation openings in the roof and rear door.
5. Cable access provisions in the roof and base.
6. Grounding bus bar.
7. Rack-mounted, 550-cfm (260-L/s) fan with filter.
8. Power strip to accommodate all equipment.
9. Baked-polyester powder coat finish.
10. All cabinets keyed alike.

G. Wall Mounted Cabinets:

1. Single door wall-mount cabinet, for indoor use, or approved equal:
2. Nominal Dimensions 24” Tall x 24” Wide x 8” Deep;
3. 0.125" thick aluminum alloy type 5052-H32 or 14ga steel construction with fully welded seams;
4. NEMA Type 3R and/or 4X;
5. Solid door with 3 latch locking handles (all cabinets keyed alike) and seamless closed-cell neoprene gasket;
6. Power strip to accommodate all equipment;
7. Grounding bus bar

H. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.

3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.4 GROUNDING:

A. Comply with requirements in Division 07 05 26 "Grounding and Bonding" for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4-inch-thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V. C. Comply with J-STD-607-A.

2.5 CCTV SYSTEM – POLICE OBSERVATION DEVICES (PODS):

A. MNR will procure, configure and test the CCTV system PODS for the project. The Contactor shall install the PODS, configure and test the CCTV PODS.

B. The information below is general for the equipment and shall be used by the contractor as supplemental information.

C. GENERAL:

1. The CCTV system POD is an out-door, pole/wall mounted enclosure that communicate with the Head-end equipment through a cellular network.
2. Each PODS shall consist of a POD enclosure manufactured by Solar Grid Surfer. Each POD shall have 4 Cameras connected to it.
3. The Contractor shall ensure the system provided meet all general and functional requirements specified in this section. If the system does not meet a specific requirement specified, provide explanation and proposed alternative. Submit requests for approval at least 45 days prior to the commencement on testing or on the first production unit.
4. The Contractor shall identify and manage all physical and logical interfacing among all existing and new systems provided under this contract to ensure that all communications, processes, and interactions between devices, subsystems and the overall system operate as defined by contractual requirements.
5. Survey equipment locations. Install equipment to provide Camera coverage for the areas required; provide unobstructed, display clear views of these areas at all current monitoring locations (Command Center(s) and desktop PCs); provide video recordings capable of being played back to produce the original, identifiable images which were recorded. Field of View (FOV) drawings shall be supplied demonstrating camera views of complete coverage. Pan-Tilt-Zoom (PTZ) camera coverage shall display as fixed position showing 70 degrees at 150 foot in layered PDF and AutoCAD formats allowing individual cameras FOV to be enabled/disabled.

6. Any variation to security devices shall require prior approval of the LIRR Office of security and shall be submitted under separate cover for an individual specific use/location per request.
7.

D. FEATURES AND FUCNTIONALITY:
1. In general, cables installed inside a cabinet or console shall be flexible type. The CCTV cameras will be IP and therefore utilize the system's Structured Cabling for communication from the CCTV camera to the security rack. Pan/Tilt/Zoom (PTZ) cameras shall run over single structured cable (signal and power) to support the operation of the camera motor to pan, tilt and zoom. Should at time of installation, power requirements for PTZ cameras be fully operational (signal and power) over separate Structures Cables, the Contractor shall submit this change to LIRR for approval.
2. The Contractor shall provide integration with MNR and MTA PD current Video Management System, Genetec.
3. Fasteners used to install certain equipment shall be tamper resistant.
4. All manufactured products shall be thoroughly tested and proven in actual use.
5. The manufacturer shall repair or replace without charge, manufactured products proven defective in material or workmanship for the stated warranty period from the date of shipment.
6. If applicable, all reference to fixed cameras shall require prior approval to specific locations, general interpretation of use is not permitted. Prior approval for all cameras (including but not limited to 360 degree viewing camera, elevator cameras, etc.) shall be required and approved by MNR and MTA PD.
7. Unless otherwise noted on the Contract documents, It is the requirement and responsibility of the contractor to fully configure all MNR conventions, such as but not limited to CCTV System naming, camera naming, IP addressing, and other MNR specific designations, e.g., device location coordinates (latitude/longitude/altitude) where required within MNR System

E. EQUIPMENT:
1. The Enclosure shall consist of the following:
   a. Cellular Modem: M2M Cellular Gateway Router
   b. Cellular Antenna
   c. Network Switch: Cisco IE 1000-8P2S-LM (2 per enclosure)
   d. UPS system
   e. Enclosure monitoring and control devices
   f. Surge protection
   g. NVR: Image Point Eclipse i5: 500 Gb MSATA, 16 Gb DDR4, Windows 10 Pro with and external HD of 4TB SSD.
   h. Genetec SCS Base version license for the installed devices
2. CCTV Camera:
   a. All cameras shall be IP (digital) cameras.
   b. All IP cameras shall be Pan-Tilt-Zoom (PTZ) unless prior written authorization is approved by the MNR and MTA PD. PTZ functionality can be either mechanical (motorized) or logical (software) based and shall be at the discretion of the MNR and MTA PD.
   c. PTZ cameras shall have a pre-defined "Home" position.
   d. All cameras shall be supplied with perpetual licenses
   e. All cameras shall be capable of bulk updating firmware, analytics, and camera configurations, as well as all other configurable settings.

f. There shall be sufficient and uniform lighting to capture all visible skins characteristics (that is, blemishes, moles, marks, etc.).
g. Camera Model: Panasonic WV-S2531LN 1080p H.265 (4 per enclosure)

2.6 COMMUNICATIONS CABLES:

A. Copper Cables:
1. General
a. All cables shall be installed inside rigid steel conduits, except where cable tray systems are utilized, or unless otherwise shown on the Contract Drawings.
b. All communication cables, that shall be provided and shall be installed inside, shall be provided with a durable Thermoset LSZH Cross-linked Polyethylene Insulation and Low Smoke Zero Halogen Jacket overall.
c. For internal wiring of electronic components: Where electronic components are the manufacturer's standard product line, internal wiring shall be the manufacturer's standard. The Contractor shall submit samples of proposed types of wire and wiring methods for approval.
d. All inside plant cables shall be either UL listed Type XHHW-2 for service at 90C wet and dry or UL Listed Type CM and shall be specifically formulated and manufactured for low smoke and low flame spread as well as zero halogen classification per the following:
1) UL 1685/VW-1
2) IEEE 1202/FT-4
3) NFPA 130
2. Low Smoke, Zero Halogen Network Cables for Voice and Data: Selection and application of copper telecommunication cable shall be balanced twisted-pair telecommunications cabling meeting the requirements for Category 6 in accordance with TIA 568-C and meet the requirements of NEMA WC 63.1. All installed Network copper communication cables shall be minimum copper 4-pair, No. 24 AWG UTP, Category 6, tested to 500-megahertz for voice and data.
3. Complete construction shall pass IEEE 1202/FT4 flame test and be UL listed. Completed construction shall comply with NFPA 130, and below:
4. Insulation: LSZH Cross Linked Polyolefin, Nominal wall thickness 8-mils
5. Pairs: Two insulated conductors cabled together with varying lays.
6. Conductors shall conform to ASTM B3.
7. Color Code per ICEA S-80-576

Pair	Conductor 1	Conductor 2
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown

8. Cable the four pairs around a LSZH cross web separator at a nominal 5-inch lay.

9. Tape: Optional barrier tape over cabled core
10. Jacket: Low smoke, zero halogen, Polyolefin jacket with a nominal wall thickness of 25-mils on non-shielded and 31-mils on the shielded cables

B. Fiber Optic Communications Cable:

1. For Single Mode Fiber, the Contractor shall install Dielectric SM Ribbon Fiber Optic Cable. For Multimode fiber, MNR Communications requires OM4 fiber.

2. Cable must conform with RUS 7 CFR 1755.900 requirements where applicable and be RUS/REA listed.

C. Control Cable:

1. The multi-conductor communication control cable shall be constructed of unshielded multiple insulated conductors of No. 16 to 24 AWG stranded tinned copper wires in accordance with ASTM B8 and B33. All conductors shall utilize 25-mils of low-smoke zero-halogen (LSZH) thermoset cross-linked polyolefin insulation conforming to ICEA S73-532 and be UL listed for both 90-degrees Centigrade wet and dry and 600-volt. Insulated conductors shall be cabled with a suitable binder tape and covered with an LSZH black, thermoset cross-linked polyolefin jacket. All cables shall be UL listed Type TC in accordance with UL 1277.
2. All individual insulated conductors utilized in multi-conductor cables shall meet all the requirements set forth herein, except that UL print is not required on the insulation. Multi-conductor cables shall also meet NFPA 130.

D. Backbone Distribution Telephone Cable: The cable shall consist of 2, 6, 12, 25, 50, or 100 unshielded twisted pairs of insulated No. 19 through 24 AWG solid copper wires protected inside a thermoset cross-linked polyethylene insulation as shown on the Contract Drawings. For the 25 pair No. 22, the wire insulation shall be 11-mils with a 50-mil jacket overall. For the 50 pair No. 19, the wire insulation shall be 16-mils with a 60-mil jacket overall. All of the pairs shall be cabled with a 1-mil binder tape over the core. The jacket shall be a flame-retardant, LSZH polyolefin. This cable shall be designed for (telephone) "punch-down" block termination. Provide ICEA P-61-694 standard colors designated for this cable type. The completed cable construction shall pass IEEE 1202/FT 4-flame test and be UL listed as Type CM.

E. Completed construction shall comply with NFPA 130.

F. Shield:

1. Shielding is required for backbone distribution cables installed in tunnels or as shown on the Contract Drawings. A 25-mil continuously corrugated and welded aluminum sheath shall be applied.
2. Shield Jacket: A black LSZH Polyolefin jacket overall with a nominal 70-mils.
3. Shielded backbone distribution cables shall meet requirements of RUS Bulletins 1753F-205 and 206 as applicable.
4.

2.7 CABLE LADDER RACK AND CONDUITS:

A. Refer to Communications spec 27 15 00 Communications Horizontal Cabling for further details.

PART 3 - EXECUTION

3.1 GENERAL COMMUNICATIONS SYSTEM INSTALLATION:

A. Prior to installation, The Contractor shall survey all sites to ensure submitted drawings accurately represent the current field condition. Contractor shall make any modifications to drawings to reflect any changes based on survey results.
   1. Prepare forms to document information, such as names of participants, date of survey, room and cabinet location information, rack layout information, and such other information as may be required.
      a. Submit the form for approval.
      b. Submit the data for approval.
      c. Submit the survey schedule for approval. Conduct the survey in the presence of the Engineer, in accordance with the approved schedule.

B. Installation of all equipment shall be in accordance with manufacturer's recommendations, and approved drawings.

C. The communications closet at the stations shall not be used for the installation of any equipment.

D. All wiring shall be neatly installed, and wire ways shall be utilized wherever possible. All wiring shall be identified at both ends by wire markers.

E. Utilize appropriate sized conduits, pull and junction boxes, condulets, troughs, cable tray, flexible conduit and fittings. The Contractor shall furnish and install all required cable types with associated spares to each location as required. The Contractor is responsible for equipment start-up, testing and installation of required interconnections.

F. The Contractor is responsible for incidentals and appurtenances necessary to complete the work as specified herein and as shown on the Contract Drawings.

G. Install Communications system equipment in locations as approved on the Contract Drawings. All conduits to the equipment shall be properly sized GRSC.

H. Cabling to Communications system components shall be CAT6A, and cable lengths, including patch cords, shall not exceed 300 feet. Fiber optic cabling shall be installed as required.

I. The switch end of each Category cable shall be punched down to a new patch panel and shall be labeled with the device name of the attached device. The patch panel shall also be labeled with the attached device.

J. Fiber Optic Patch Panels shall be labeled with the room or cabinet that is at the other end, and the Patch Panel labels shall all be filled out and indicate the device on the opposite end or that the strand is spare.

K. No Ethernet connected device shall be installed until its cabling is properly labeled.

L. The device end of each Category cable shall be labeled indicating the originating rack or cabinet.

M. All wire runs shall be continuous, and color code of the wire in all circuits shall not change throughout the circuit unless otherwise noted.

N. The Contractor shall label each Communications system component with a label containing the following items, the Contractor shall submit an example label to MNR for approval prior to labeling Communications system components:
1. Location designation
2. The equipment ID number from the approved installation drawings
3. The device ID

O. All labels used shall be machine printed yellow weatherproof labels and withstand rain, sleet, snow, dust, and temperatures of -20°F to 160°F. Font and font size shall be approved by MNR.

3.2 CCTV SYSTEM PODS INSTALLATION/CONSTRUCTION:

A. Installation:
1. Where applicable, provide camera dome mounting arms and brackets as recommended by the manufacturer. Camera mounts shall include but not be limited to the following types: pendant, pipe, I-Beam, pole, ceiling, hanging ceiling, embedded/recessed, outside corner, inside corner, shepherd's hook, cornice, etc.
2. Install all conduits for the CCTV System equipment being furnished under the Contract unless otherwise noted. All equipment and wiring shall be installed supervised by the Contractor in accordance with the manufacturers' recommendations.
3. Information shall be submitted for pre-approval before the installation begins, catalog cut sheets and shop drawings are to be submitted for approval.
4. The contractor shall perform all settings, adjustments, configurations and programming required for a complete and operational CCTV System, as approved and as directed by MNR and MTA PD. The contractor shall submit all settings, adjustments, and programming information for MNR and MTA PD approval.
5. The contractor shall configure the recording and camera control equipment at the Head end to parameters supplied by MNR and MTA PD.
6. Furnish and install required hardware and brackets to install the equipment as specified and as required. Furnish and install all required rack mounting kits to install the equipment as specified and as required.
7. Provide tamper resistant fasteners for any junction boxes and camera housings.
8. The Contractor shall use power over Ethernet (POE) technology to support camera and CCTV System device connectivity wherever possible.
9. All (POE) cable runs shall be less than 70 meters (210 feet) from point of origin (equipment head end) to point of termination (camera). For installations >70 meters (210 feet), fiber optic cabling shall be used for CCTV System device/camera connectivity.
10. For all POE-Cabled Cameras exceeding 70 meters, media converters may be used to convert CAT6 connections into Fiber Optic connections. Media converters shall be POE capable:
    a. For fiber optic cable applications, alternatively a secondary low voltage DC power cable shall be installed to support camera/device power. If a DC connection cannot be facilitated, the contractor shall be required to provide separate AC power to the remote camera/device location.

b. Alternatively, at the camera location with fiber optic cables, the cable shall be terminated on a small form factor POE switch to be installed within a junction box either attached to or located near the camera.
c. At the camera location, and for locations that exceed the 70-meter CAT6 limit and require multiple cameras to be installed within a defined area, the contractor may install a fiber optic cable to be terminated on a multi-port, small form factor, POE switch located within suitable equipment housing within a junction box either attached to or located near the camera.

11. The CCTV System Vendor shall have the responsibility for providing the Contractor with hardware and software design modifications, engineering expertise and on-site support services required to integrate the video surveillance system into the existing MNR and MTA PD systems.
12. The CCTV System Vendor shall provide, including but not limited to hardware and software, engineering expertise and on-site services to allow the viewing of on-screen images transmitted to the MNR and MTA PD systems via the video surveillance system. The CCTV System Vendor shall also verify all recording and data-collection functions and demonstrate video recording playback of archived video recordings from each location.
13. The CCTV System Vendor shall provide hardware and software engineering expertise and on-site services to oversee and supervise any modifications made to MNR and MTA PD systems by the Contractor's employees or sub-contractors.
14. The CCTV System Vendor and the Contractor shall take the necessary precautions required to maintain the Administrations warranties with the existing MNR and MTA PD system.
15. The CCTV System Vendor and the Contractor shall participate in all cutovers, tests and trials required to independently verify and validate the video download functionality between the video surveillance system and the existing MNR and MTA PD monitoring system.

B. Survey:

1. The contractor shall perform physical surveys of all proposed camera locations.
2. The contractor shall be responsible for determining optimum camera views of the affected areas and assets to be covered. The following locations, at a minimum, shall be viewable by CCTV cameras: facility ingress/egress points, public doorways, stairways, escalators, elevators, pedestrian and/or motor vehicle choke points (e.g., gates, connecting corridors, turnstiles, etc.), employee facility doorways, public hallways and corridors, balcony areas, train platform areas (end of platform, edge of platform), moving walkways, other points of interest (transportation arrival/departure information signs, information kiosks, etc.), agency identified critical infrastructure, vestibules, general public gathering areas, waiting rooms, facility dead-end areas, agency ticket vending machines, and ATM/cash machines.
3. All surveys shall be coordinated with MNR and MTA PD for final device design and placement.
4. During surveys, the Contractor shall use approved portable cameras (specific to the application), suitable lenses, portable power, and adjustable height support poles to facilitate determining camera placement locations (including camera height from the floor), installation requirements, required mounting hardware and configurations, proper fields of view (FOV), and distances to target.
5. The Contractor shall provide all required equipment (test cameras, lenses, portable power supplies, support poles, cables, and connectors) for all surveys.
6. The Contractor shall determine all appropriate camera mounting hardware required to support each camera installation.

7. Camera mounting heights shall be no less than 9 feet and no higher than 13 feet above the floor. Deviations in mounting heights shall be at the discretion and approval of MNR and MTA PD.
8. The Contractor shall measure and provide written detail on all camera fields of view including, but not limited to, camera placement, width of coverage (angle of lens), distance to target, and pixels on target (pixels per foot).
9. All changes in ceiling pitch, slopes of the floor, deviations in corridor widths, and wall angles/curves shall be accounted for during field of view surveys and camera location surveys to eliminate coverage dead spots or zones.
10. The contractor shall provide graphical representations (drawings) marking the boundaries/limits of the area of each camera's facial recognition coverage (reference standard measurements for facial identification in good conditions @ 80 pixels/foot). The contractor shall also provide MNR and MTA PD with distances and pixel/foot measurements for other selected targets within a camera's FOV (for record purposes).
11. Camera dead zones are to be no less than 5 feet and no greater than 20 feet (from the camera). Dead zone depths shall vary based on the following elements: camera type, lens type and characteristics, field of view (available, required), camera purpose (detection, recognition, and identification), physical layout of the facility being covered, operating environment, and camera mounting options. Final determination of a camera's dead zone shall be provided to the contractor by MNR and MTA PD.

3.3 TERMINATING COMMUNICATIONS WIRES:

A. Terminate all conductors to comply with the applicable industry.

B. Communication type cables shall be so terminated that the length of the individual conductors exposed outside of the cable jacket is held to a minimum. In order to accomplish this, terminate the wires of each cable as close together as possible, all as approved.

C. When terminating a new cable in an existing piece of equipment, where available facilities are not sufficient, provide new terminating facilities within the equipment and rearrange existing terminating facilities and terminations, if required, in order to terminate the new cable. Terminate the new cable in accordance with approved working drawings. Perform work of this nature only in the presence of a duly authorized representative of MNR.

D. The Contractor will be allowed to cut existing tags and remove them from wires without removing the wires from the terminal post. Apply new tags to existing cable pairs and wires carrying special circuits by means of an approved nylon cord in an approved manner. Exercise care in removing old tags to prevent damage to the wires or the insulation or braid on the wires.

E. Wiring shall be done in a neat and skillful manner and have a satisfactory final finished appearance.

F. Install cable, conduit and raceways in such a manner as to minimize visual impact.

G. The maximum run length for copper data cabling shall not exceed 300 feet. Calculate and submit for each run total cable length including the rise and drop of the cable from floor to ceiling.

H. Calculate the link budget requirements during design. Measure actual total attenuation of link prior to installation to ensure adequate transmit and receive power level. At each stage, submit for approval the calculated and measured link budget for all links.

I. All cable installation shall meet the minimum bend radius per cable manufacturer and MNR requirements.

J. Where it is required to make wiring changes, remove the existing lacing twine or tape from the wiring trees for the addition or removal of wires. After such changes have been made, reshape and re-tape the wiring trees in a neat manner and as approved, using cable ties manufactured by 3M Co., or approved equal. Wiring and tagging shall be done in a neat and skillful manner and have a satisfactory final finished appearance. The amount of slack required in cable and wire shall be as required.

K. Terminating wires and cables in equipment
1. Pull the end of the wire or cable into the case or other equipment housing for an approved distance. Closely and neatly group the wires of the cable and bundle them at a maximum of 4-inch intervals using an approved cable tie.
2. Loop the group of wires around in the equipment housings to allow for sufficient slack as directed and then spread out and terminate. Form and support the wires in an approved manner to remove the weight of the wires from the terminals. Ensure that the internal wiring does not become damaged and is not crowded out of shape.
3. Some equipment is provided with hand holes to facilitate pulling and connecting wire and cable. Whenever a hand hole is removed, replace it in such manner as to make an absolutely watertight seal.
4. Terminate cable pairs in the sequence indicated by the cable color code.

3.4 COMMUNICATION CABINETS:

A. The cabinet shall be of stainless steel construction, NEMA 4X "style" with the exception of 3-point latch door hardware vs. true NEMA 4X multiple clamping assemblies on the individual doors and partially open bottom

B. The cabinet shall contain all equipment rack hardware to accommodate the Communications systems, Security Equipment and electrical distribution and electronic communications equipment.

C. The cabinet shall provide for the mounting and termination of the following equipment and material as a minimum:
1. Main electrical distribution panel with main breaker
2. Protected power strips
3. Power supplies
4. Fiber optic cable splice enclosures
5. Fiber optic cable slack, patch panels and cable management
6. 10 Gigabit Ethernet network switch stack
7. Health Data
8. Temperature Data
9. Cat 6 Patch panels
10. Fiber optic media converters, modems, and patch panels
11. Intrusion components
12. All internal interconnection wiring, cabling, fiber optic cabling and patch cords between equipment racks and terminal blocks
    a. Utility lighting and convenience receptacles

D. The cabinet shall be provided with cooling and heating unit, as required to maintain a thermostatically-controlled stable operating temperature/environment based on the manufactures recommendations for the electric/electronic equipment installed within.

E. The total assembled cabinet structure shall be constructed as a rigid, self-supporting structure that when handled for shipping and placement on foundation shall not warp or deflect internally the roof, outer doors or skin.

3.5 CABINET GROUNDING:

A. Each cabinet shall be equipped with three (3) copper grounding bus bars (for Electrical system, Chassis and communications grounding). Bus bars shall be located near the bottom of the cabinet and be mounted on insulators that electrically isolate the cabinet from the bus bar.

B. Bus bars shall be 12 X 1 X 1 /4 inch thick, solid copper bar, predrilled for connection of individual grounds.

C. The grounding bus bars shall each be bonded to each other with a #4 AWG green insulated copper conductor. The ground bus in the electrical distribution section will be connected to a single #2 group tap on the station ground grid.

D. Internal chassis grounding arrangement shall utilize #6 AWG green insulated, stranded ground wire connected to the Chassis Grounding Bus bar (CGB) per contract drawings.

E. Electrical system ground wire from the station electrical panel enclosure shall be grounded to the cabinet distribution panel ground bus and in turn bonded to the ground bus in the electrical distribution section, per Contract Drawings.

F. Protected Terminal Block ground shall be connected to the CGB using #6 AWG ground wire per Contract Drawings.

G. All electronic equipment grounds shall be grounded; using #1 0 AWG green insulated stranded copper conductors, to the Telecommunications Grounding Bus bar (TGB).

H. Shields from signal cables shall be grounded to the TGB.

I. Refer to Communications spec 27 05 26 Grounding and Bonding for Communications Systems for further details.

3.6 START UP AND INSPECTION:

A. Perform standard tests of all data network and telephone system cabling. Tabulated results of these tests shall be submitted for Design Professional's approval.

1. Inspection:

a. Visually inspect the installation of all equipment to ensure compliance with construction and electrical codes and normally accepted standards of workmanship. If, upon inspection, changes are found to be necessary, the Contractor shall make such changes promptly at no additional expense to the Contracting Party, or to the Authority.

b. Visually inspect UTP jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at SIOs to confirm color code for T568B pin assignments, and inspect cabling connections to confirm compliance with EIA/TIA-568-C.1, EIA/TIA-568-C.2.

3.7 COMMUNICATIONS SYSTEM TESTING:

A. The Contractor shall plan for, perform, monitor, and document all tests required to prove the design and acceptability of the Communications system, including all elements, subsystems, and the system as a whole, installed under this Contract. The Contractor shall furnish Communications system equipment that meets the criteria specified for all tests. Testing shall not commence until all designs affecting the respective equipment and MNR or its designated representative has approved all related testing procedures. The testing shall be provided for all Communications system equipment and systems.

B. The Contractor shall perform all Acceptance Tests for both individual systems as well as the integrated system as per this specification section. This shall include functionality, performance, reliability and interoperability testing (with the systems currently installed) of the systems in the solution. Contractor shall submit test plan, procedures, and expected results to the Engineer for approval prior to work.

C. Data sheets shall be provided to the Engineer prior to time of testing to verify and document that each and every piece of equipment used during testing shall be in compliance with all applicable manufacturer, UL, IEEE, MNR or governmental requirements.

D. MNR may require the Contractor to submit proof of test acceptability of any item at any time during the duration of this Contract. A statement by the Contractor, manufacturer, or supplier of any item, without the appropriate substantiating evidence, shall not constitute adequate proof of acceptability, unless approved by MNR.

E. Perform testing for every network interface device in this contract as follows:
1. The Contractor shall perform all Acceptance Tests for both individual systems as well as the integrated system as per this specification section and section 27 15 00. This shall include functionality, performance, reliability and interoperability testing (with the systems currently installed) of the systems in the solution. Contractor shall submit test plan, procedures, and expected results to the Engineer for approval prior to work.
2. Data sheets shall be provided to the Engineer prior to time of testing to verify and document that each and every piece of equipment used during testing shall be in compliance with all applicable manufacturer, UL, IEEE, MNR or governmental requirements.
3. The above shall be submitted by the Contractor to the Engineer for approval at least three (3) months prior to the commencement of the testing. The Contractor shall incorporate all changes initiated by the Engineer, if such changes are required, and resubmit the test procedure for final approval. The tests shall be conducted in strict adherence to the approved testing procedures. No changes in testing procedures shall be made unless specifically approved in writing by the Engineer. As part of testing, Contractor shall include 15% additional time for unplanned tests as directed by the Engineer.
4. These tests shall attempt to duplicate the connectivity configuration of the system when installed at MNR.

5. Any malfunctions or irregularities shall be documented and corrected by the Contractor. A re-inspection and retesting of the corrected malfunctions and irregularities shall be performed to the extent directed by, and witnessed by, the Authority. Such tests shall be at no additional expense to the Contracting part, or to the Authority.
6. Acceptance testing shall be witnessed by the Authority's representatives, which may include the Authority's craft personnel in training.
7. The priorities for acceptance testing and placing into service of equipped circuits shall be subject to the Engineer's directives and approval.
8. The Contractor shall provide all personnel, material, instruments and apparatus to conduct the acceptance tests. The Contractor shall certify that all test equipment used has been accurately and currently calibrated.
9. A record shall be kept of all completed tests, whether successful or not. When a test is unsuccessful, the Contractor shall take whatever remedial action is necessary, and rerun the test until it is successfully completed. The reason for each unsuccessful test and the remedial action taken shall be provided in writing to the Engineer. All parts and labor used for repair of the system during testing shall be provided by the Contractor at no additional expense to the Contracting Party, or to the Authority. If any spare parts are used by the Contractor during testing, they shall be replaced by the Contractor at no additional expense to the Contracting Party, or to the Authority.
10. Certified test reports showing compliance with the requirements of the Contract and OEM Specification for the equipment furnished under this Contract shall be submitted to the Engineer's approval. Testing shall be performed on all equipment required under this Contract.

3.8 CCTV SYSTEM TESTS:

A. Upon installation, Contractor is required to demonstrate the operability of the CCTV system functions to the satisfaction of MNR and MTA PD The Contractor shall provide the services of the CCTV System manufacturer for the startup and testing of the CCTV System.

B. Validate the following for each camera at locations specified by MNR and MTA PD:
   1. Camera is operable and properly displays image at required locations
   2. Pan/Tilt/Zoom features of each camera are operable within the manufacturer’s CCTV System remotely from the MNR and MTA PD Operation Command Center and within the then current integrator by version with full operational capabilities.
   3. Upon alarm from Security System camera at (or in the vicinity) of alarm location is displayed at the security workstation.

C. Video Monitors and Workstations
   1. Can properly view any camera requested throughout the facility.

D. Digital Network Storage:
   1. Properly stores all required video in format specified.
   2. Functionality of operations (playback/rewind/..) of approved playback software properly operates.

E. Integration with Security system:
   1. Upon alarm from security systems, CCTV System shall provide video surveillance of these areas within the then current integrator of the MNR and MTA PD Security system.

3.9 FINAL VERIFCATION TESTS

A. General Communications System:
   a. Perform verification tests for UTP systems after the complete cabling and workstation outlet/connectors are installed.
   b. Voice Tests. These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and DSN telephone call.

B. Public Address System:
   a. Engage a factory-authorized service representative to perform startup service.
   b. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
   c. Complete installation and startup checks according to manufacturer's written instructions.
   d. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
   e. 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 site outside normal occupancy hours for this purpose, without additional cost.

3.10 WARRANTY

A. Communications System equipment:
   1. The equipment shall be warrantied against any defects in material and workmanship, under normal use, for a period of 2 years from date of installation. If system is found by manufacturer to be defective within the warranty period, manufacturer shall repair and/or replace any defective parts, provided the equipment is returned to manufacturer.

END OF SECTION

SECTION 32 12 00 - FLEXIBLE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Contract Drawings and other Contract Documents, including the General Conditions, Supplementary Conditions, and Division 01 Specification Sections, apply to the Work of this Section.

B. Related Sections include the following:
   1. Section 01 33 00 - Submittal Procedures.

1.2 SUMMARY

A. This Section specifies requirements for existing ground preparation and asphaltic concrete paving.

1.3 REFERENCES

A. Reference Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. AASHTO T 168 – Standard Method of Test for Sampling Bituminous Paving Mixtures.
      b. AASHTO T 245 – Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
   2. ASTM International (ASTM):
      a. ASTM D 29 – Standard Test Methods for Sampling and Testing Lac Resins [*withdrawn 2005 without replacement*].
      b. ASTM D 36 - Standard Test Method for Softening Point of Bitumen (Ring-and- Ball Apparatus).
      c. ASTM D 464 - Standard Test Methods for Saponification Number of Naval Store Products Including Tall Oil and Other Related Products.
      d. ASTM D 465 - Standard Test Methods for Acid Number of Naval Stores Products Including Tall Oil and Other Related Products.
      e. ASTM D546 Standard Test Method for Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures
      f. ASTM D692 Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures
      g. ASTM D946 Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
      h. ASTM D1073 Standard Specification for Fine Aggregate for Bituminous Paving Mixtures
      i. ASTM D1188 Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
      j. ASTM D 2041 - Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.

Addendum 6

k. ASTM D2726 Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
l. ASTM D2950 - 09 Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
m. ASTM D3549 Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens

3. American Wood Preserver's Association (AWPA):
   a. AWPA P5 Standard for Waterborne Preservatives.
   b. AWPA C1 Pressure Treatment.
   c. AWPA C14 Pressure Treatment – Highway.
4. State of New York:
   a. New York State Department of Transportation (NYSDOT):
      1) NYSDOT Standard Specifications (U.S. Customary Units). https://www.dot.ny.gov/main/business-center/engineering/specifications.
      2) New York State Standard Sheets (U.S. Customary Units). https://www.dot.ny.gov/main/business-center/engineering/cadd-info/drawings/standard-sheets-us.
   b. Official Compilation of the Rules and Regulations of the State of New York (NYCRR).
      1) 12 NYCRR Part 23 - Protection in Construction, Demolition and Excavation Operations.
      2) 16 NYCRR Part 753 - Protection of Underground Facilities.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Testing Laboratory:
      a. Metro-North will engage a qualified testing agency to perform tests and inspections.

1.5 SUBMITTALS

A. Action Submittals:
   1. Submit the following to the Engineer for approval in accordance with the requirements of Section 01 33 00, Submittal Procedures:
      a. Product Data:
         1) Design mix formula to be used.
         2) Sources of all ingredient materials, copies of all aggregate tests, penetration of the asphaltic cement, and percentages by weight and number of pounds of each of the materials making up the batch.
      b. Certificates:
         1) NYSDOT certified mixing plant to be used. Provide proof of certification.
      c. Special Procedure Submittals:
         1) Specifications of equipment to be used for paving operations.

B. Informational Submittals:
   1. Submit the following to the Engineer for information in accordance with the requirements of Section 01 33 00, Submittal Procedures:
      a. Site Quality Control Submittals:

1) Test reports, trip tickets, temperature records and other certifications that show materials are in compliance with specifications.

b. Final density and smoothness test results.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:

1. Transport asphaltic mixtures in tight vehicles having clean and smooth metal beds.
   a. When necessary, insulate truck bodies.
   b. Just before the vehicles are loaded, lightly coat the inside surface of the vehicles with a whitewash of lime and water, soap solutions, or detergents as approved by the Engineer; or with fuel oil applied by a high pressure fog system.
2. Cover each load with canvas or other suitable material to protect the mixture from the weather.
3. Deliver stone at a temperature not exceeding 350°F.

B. Storage and Handling Requirements:

1. Heating and Storing Asphaltic Paving Mixture Ingredients:
   a. Heat asphaltic cement in approved receptacles to a temperature between 275°F and 350°F.
   b. Keep asphaltic cement uniform in composition and consistency.
   c. Heat aggregate in approved revolving driers.
2. Hot Asphaltic Mixture Holding Bins:
   a. Store hot asphaltic mixtures at the mixing plant or satellite sites in bins that are currently approved by NYSDOT.
   b. After storage, maintain the mixture as indicated in Table 32 12 00-1.

Table 32 12 00-1 Hot Asphaltic Mixture Storage Requirements

Test Property	**Allowable Variation**
Temperature	± 20°F from pug mill discharge temperature
Gradation	Within job mix formula tolerance
Asphalt Content	Within job mix formula tolerance
Asphalt Cement Recovered from Mixtures:	
Penetration @ 77°F	Loss not to exceed 50% of the penetration of the asphalt sampled prior to mixing.
Viscosity @ 140°F	Viscosity not to exceed 4 times the viscosity of the asphalt sampled from the plant prior to mixing.

1.7 SITE CONDITIONS

A. Ambient Conditions:
1. Spread and compact mixtures during daylight.
2. Schedule the placement of asphaltic paving material when the Precipitation Probability from the U.S. Weather Bureau, obtained within 3 hours prior to the start of such operations is less than 50 percent.
   a. Notify the Engineer of the exact time at which the above information was obtained.
3. Do not lay mixtures in wet weather.
4. Do not lay permanent asphaltic mixtures when surface temperatures are below those listed in Table 32 12 00-2:

Table 32 12 00-2 Minimum Surface Temperatures for Laying

Compacted Lift Thickness	Minimum Surface Temperature
3 inches or greater	40° F
Between 1 inch and 3 inches	45° F
1 inch or less	50° F

   a. Take surface temperatures at 3 locations in the area being paved.
   b. The controlling temperature are the average of the 3 readings.
5. Temporary pavements are not subject to the above requirements, but must be placed as approved by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Asphalt Cement:
1. Furnish viscosity grade AC-20 asphalt cement complying with the requirements specified for material designation 702-03 in Section 702 of the NYSDOT Standard Specifications, and with the requirements specified for Penetration Grade 60-70 specified in ANSI/ASTM D946.

B. Coarse Aggregates:
1. Furnish coarse aggregates complying with the requirements specified in ASTM D692 as amended or supplemented by the requirements specified in Section 401-2.02 of the NYSDOT Standard Specifications.
2. Furnish coarse aggregates having the gradation specified in Table 32 12 00-1.

C. Mineral Filler:
1. Furnish finely divided mineral matter, such as rock dust, hydrated lime, hydraulic cement, fly ash, loess, or another material as determined and approved by the Engineer.

2. Furnish mineral filler sufficiently dry to flow freely and essentially free from agglomerations, organic impurities, and other objectionable materials.

D. Sand:
1. Conform to the requirements for fine aggregate in ASTM D-1073 and as amended or supplemented by Section 401-2.02 of the NYSDOT Standard Specification.

E. Aggregate Base:
1. Conform to NYSDOT Standard Specifications Section 304, Type 2.

F. Wood Header:
1. Preservative: Wolman CCA Type C in accordance with AWPA Standard P5.
2. Pressure treated to conform to AWPA Standard C1 and C14.

2.2 MIXES

A. Asphaltic Paving Mixture:
1. Provide a bituminous plant mix composed of a mixture of aggregate, filler and bituminous material.
   a. Thoroughly coat the aggregate with asphaltic cement.
2. Provide a bituminous plant mix complying with the requirements indicated in Table 32 12 00-2.

Table 32 12 00-2 Plant Mix Composition

Use	**Asphaltic Binder**		**Asphaltic Surface Course**	
Screen Sizes	**General Limits % Passing**	**Job Mix Tolerance %**	**General Limits % Passing**	**Job Mix Tolerance %**
1-1/2-inch	100	-		-
1-inch	95-100	-		-
1/2-inch	70-90	±6	100	±7
1/4-inch	48-74	±7	90-100	±7
1/8-inch	32-62	±7	45-40	±7
No. 20	15-39	±7	15-40	±7
No. 40	8-27	±7	8-27	±4

Table 32 12 00-2 Plant Mix Composition

Use	**Asphaltic Binder**	**Asphaltic Surface Course**

Screen Sizes	General Limits % Passing	Job Mix Tolerance %	General Limits % Passing	Job Mix Tolerance %
No. 80	4-16	±7	4-16	±2
No. 200	2-8	±7	2-6	
Asphalt Content %	4.5-6.5±0.4		5.8-7.0±0.4	
Mixing and Placing Temperature Range °F	250°-325°		250°-325°	

3. Base aggregate tolerances on the total weight of the aggregate and the bitumen tolerances on the total weight of the mix.

2.3 SOURCE QUALITY CONTROL

A. Tests:
1. Gradation Test:
a. Test Procedure:
1) Have the Testing Laboratory perform Gradation Tests in accordance with the method specified in ASTM D546.
b. Acceptance Criteria:
1) Coarse aggregate and mineral filler meeting the gradation requirements indicated in Table 32 12 00-1 pass the Gradation Test.

Table 32 12 00-1 Coarse Aggregate and Mineral Filler Gradation	
Sieve Size	**Percent Passing (by Weight)**
No. 30	100
No. 80	85-100
No. 200	65-100

B. Non-Conforming Work:
1. Do not furnish coarse aggregate and mineral filler that fail the Gradation Tests.

PART 3 - PRODUCTS

3.1 PREPARATION

A. Ensure substrates are in suitable condition to receive the work.
   1. Contractor shall clean all existing joints/cracks of all deleterious material in accordance to NYSDOT Section 633, Conditioning Existing Pavement.
   2. Contractor shall seal all existing cracks with a joint and crack filler prior to asphalt overlay in accordance to NYSDOT Section 633, Conditioning Existing Pavement and NYSDOT Section 702, Materials and Manufacturing.
   3. Contractor shall mill/grind a minimum 3'x3' area of existing asphalt pavement to a depth of 1½" below existing manhole cover elevations at locations where rims are flush with existing pavement prior to asphalt overlay installation.
   4. Contractor shall mechanically sweep pavements surfaces immediately prior to commencement of asphalt overlay installation.

B. Protection of In-Place Conditions:
   1. Temporary Pavement:
      a. Furnish and lay temporary pavement wherever required to properly maintain traffic over backfilled trenches and at such other locations as may be directed by the Engineer.
      b. Temporary pavement shall consist of asphaltic binder mixtures, laid to adequate thickness and compaction.

3.2 INSTALLATION

A. Equipment:
   1. Mixing Plants:
      a. Furnish mixing plants approved by NYSDOT for use in NYSDOT construction.
      b. Ensure that the plant and plant operations are in accordance with the requirements of Section 401-3.01 "Quality Control" of the NYSDOT Standard Specifications.
   2. Asphaltic Pavers:
      a. Furnish self-power pavers having an activated screed or strike-off assembly capable of spreading and finishing courses in widths approved by the Engineer.
      b. Furnish pavers capable of spreading and finishing narrow widths of pavement.
      c. Furnish pavers equipped with a receiving hopper with sufficient capacity for uniform spreading operation and automatic flow controls.
      d. Furnish pavers having a heated screed or strike-off assembly to produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.
      e. Furnish pavers equipped with approved automatic transverse slope and longitudinal grade screed controls to automatically adjust the screed and increase or decrease the mat thickness to compensate for irregularities in the surface being paved.
         1) Provide controls capable of maintaining the proper transverse slope and readily adjustable for transitions.
   3. Rollers:
      a. Furnish tandem type power driven rollers capable of providing a pressure not less than 225 pounds per inch width of the main roll.
         1) Furnish smooth true rolls without flat spots or other imperfections.

b. Furnish self-propelled, pneumatic rubber-tired rollers with wheels mounted, grouped, and spaced to provide uniform coverage with each pass.
   1) Furnish rollers with rear group wheels that do not follow in the tracks of forward group wheel.
   2) Furnish rollers with a maximum wheel load of 5600 pounds.
   3) Furnish rollers with a tire compression on pavement, where the area of contact is measured on a hard, unyielding surface, of 80 psi, plus or minus 5 psi, for each wheel; and having a total maximum load per axle, whether single axle or a group of axles in the same alignment, of 22,400 pounds.
   4) Control wheel loads and tire pressures to produce the required degree of compaction without rutting of the surface to be rolled.

B. Headers:
   1. Install wood headers where indicated. Brace headers to support ballast until paving is installed.

C. Placing:
   1. Place surface courses and binders over aggregate base using an approved mechanical spreader.
      a. Keep the number of longitudinal joints to a minimum.
      b. Limit hand placement of asphaltic material to those areas where machine spreading and finishing is not practical.
   2. Ensure the temperature and consistency of the mix at time of application comply with the specified requirements.

D. Spreading:
   1. Do not allow the asphaltic mixture to be placed in a continuous strip exceeding 800 feet long.
   2. Lay adjacent strips immediately after each previous strip is placed until the full width of the roadway surface has been covered.

E. Binder Mixture:
   1. Using an asphaltic paver, lay the binder mixture to a depth which after final compaction is equal to the specified depth.
      a. In areas where the use of the paver is impractical, as determined by the Engineer, other approved means of spreading and compaction may be permitted.
   2. Hand Laying Binder Mixture:
      a. Uniformly spread binder mixture using hot iron rakes with tines not less than 1/2 inch longer than the loose depth of the mixture, or using a mechanical spreader, to a depth which, after final compaction, is equal to the specified depth.
      b. Thoroughly compact the binder mixture using approved tamping irons adjacent to curbs, manholes, rails, and similar structures; and with approved rollers to a surface that is parallel to and below the finished grade and crown of the finished surface.
      c. If the binder mixture breaks up, shows lack of bond, or other defects before the surface mixture is laid, take it up, and remove and replace it with suitable material at no increase in the Contract Price.

F. Surface Course Mixture:
   1. Before the surface mixture is laid, paint the contact surfaces of curbs, gutters, headers, and manholes with a thin uniform coating of approved hot asphaltic cement, liquid asphalt, or emulsified asphalt.

2. Using an asphaltic paver, lay the surface course mixture to a depth which after final compaction is equal to the specified depth.
    a. In areas where the use of the paver or mechanical spreader is impractical, other approved means of spreading and compaction may be permitted.
3. Hand Laying Surface Mixture:
    a. Uniformly spread surface course mixture using hot iron rakes with tines not less than 1/2 inch longer than the loose depth of the mixture to a depth which, after final compaction, is equal to the specified depth.
    b. No walking will be permitted on the surface mixture during the laying operations.
    c. After spreading and raking the surface mixture, carefully lute surface course mixture from the sides before compaction.

G. Compaction:
1. Rolling:
    a. Proceed rolling continuously at the following rates:
        1) For binder, base course, and drainage medium mixtures, when spread by hand, not in excess of 400 square yards per hour per roller.
        2) For binder, base course, and drainage medium mixtures, when spread by machine, not in excess of 600 square yards per hour, per roller.
        3) For asphaltic concrete surface mixtures, when spread by hand, not in excess of 300 square yards per hour per roller.
        4) For asphaltic concrete surface mixtures, when spread by machine, not in excess of 400 square yards per hour per roller.
    b. Immediately after spreading the mixture, using approved tamping irons thoroughly compact the mixture adjacent to curbs, manholes, and rails; and by rolling using approved rollers continuously from commencement to final completion at a speed not exceeding 3 mph.
    c. Make the initial rolling using steel-wheeled, power-driven, tandem type rollers parallel to the center line of the paved surface beginning at the curbs or edges of the paved surface and working toward the center, overlapping on successive trips by one-half the rear wheel of the roller.
    d. Immediately following the initial rolling, further compact the mixture by using pneumatic rubber-tired rollers for a minimum of eight passes.
        1) Smooth shallow ruts and ridges with tandem rollers immediately following the rubber-tired rolling.
2. Final Roll:
    a. Continue rolling until no further compression results; the mixture has cooled; no marks show under the roller; and the surface is smooth and free from depressions, waves, bunches and unevenness.
    b. After the mixture has been rolled, test the surface with an approved straight edge and surface testing machine laid parallel to the center line of the paved surface.
3. Vibratory Compaction:
    a. When permitted by the Engineer, use vibratory compaction in accordance with Section 402-3.07 "Option 2" of NYSDOT Standard Specifications and Section 402-3.04 "Rollers" of NYSDOT Standard Specifications.
    b. Compaction testing requirements are to conform to NYSDOT Standard Specifications Section 402-3.07.

H. Joints:

1. Lay the surface mixture in a continuous operation, and pass the roller over the unprotected end of the freshly laid mixture only when the lying of the course is to be discontinued for such length of time as to permit the mixture to become chilled.
    a. Provide for a proper bond with the new mixture by cutting or trimming back the joint to expose an unsealed or granular surface for the full-specified depth of the course.
2. At the end of each day's work, form joints by laying and rolling against boards of the thickness of the compacted mixture, placed across the entire width of the pavement.
3. When the laying of the mixture is resumed, paint the exposed edge of the joint with a thin coat of approved hot asphaltic cement or liquid asphalt, rake a fresh mixture against the joint, thoroughly tamp and roll.
4. Hot smoothing irons may be used for sealing joints.

3.3 SITE QUALITY CONTROL

A. Site Tests:
1. Test final density and smoothness after rolling and before acceptance.
2. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
3. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
4. In-place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to AASHTO T 168.
    a. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job- mix specifications.
    b. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM 2726.
        1) One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
        2) Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
5. Replace and compact hot-mix asphalt where core tests were taken.
6. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.
7. Site Inspections:

B. Non-Conforming Work:
1. Portions of the completed wearing course that are defective in finish, compression, composition or density, shall be taken up, removed and replaced with suitable material properly laid in accordance with these specifications.

3.4 PROTECTION

A. Traffic:
1. No traffic of any kind will be allowed on the pavement until permitted by the Engineer.

END OF SECTION