

PROJECT MANUAL / SPECIFICATIONS FOR

**ALTERATIONS AT
WESTOVER MAGNET ELEMENTARY SCHOOL**

412 Stillwater Ave. Stamford, CT 06902

SPN 135-0278RR

**City of Stamford
Stamford Public Schools
888 Washington Boulevard
Stamford, CT 06901**

ARCHITECT:

**KG+D ARCHITECTS, PC
285 Main Street
Mount Kisco, NY 10549**

SYSTEMS ENGINEER:

**OLA CONSULTING ENGINEERS, P.C.
50 Broadway
Hawthorne, NY 10532**

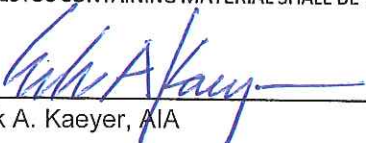
SPECIFICATIONS CONSULTANT:

**CONSTRUCTION SPECIFICATIONS INC.
22 Tennent Road, P.O. Box 448
Morganville, NJ 07751**

Construction Documents

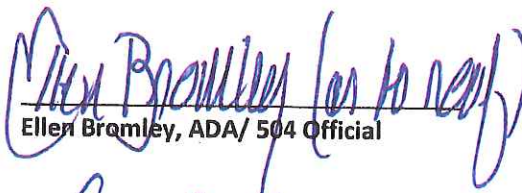
06 August 2019

THE UNDERSIGNED CERTIFIES THAT TO THE BEST OF HIS KNOWLEDGE, INFORMATION AND BELIEF, THE PLANS AND SPECIFICATIONS ARE IN ACCORDANCE WITH APPLICABLE REQUIREMENTS OF THE CONNECTICUT STATE BUILDING CODE, THE STATE ENERGY CONSERVATION CONSTRUCTION CODE, AND THAT THE PLANS AND SPECIFICATIONS REQUIRE THAT NO ASBESTOS CONTAINING MATERIAL SHALL BE USED.


Erik A. Kaeyer, AIA


Bharat Gami, City Building Official


Walter Seely, Fire Marshall


Ellen Bromley, ADA/ 504 Official

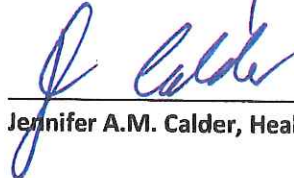

Jennifer A.M. Calder, Health Director

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Bharat Gami, City Building Official

Ellen Bromley, ADA/ 504 Official

Walter Seely, Fire Marshall

Jennifer A.M. Calder, Health Director

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

- A. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Alpha Wire Company.
 - 2. Belden Inc.
 - 3. Cerro Wire LLC.

4. Encore Wire Corporation.
 5. General Cable Technologies Corporation.
 6. General Cable; General Cable Corporation.
 7. Senator Wire & Cable Company.
 8. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2, Type XHHW-2 and Type SO.
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC mineral-insulated, metal-sheathed cable, Type MI and Type SO with ground wire.
- E. VFC Cable:
1. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable.
 2. Type TC-ER with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. 3M.
 2. AFC Cable Systems, Inc.
 3. Gardner Bender.
 4. Hubbell Power Systems, Inc.
 5. Ideal Industries, Inc.
 6. ILSCO.
 7. NSi Industries LLC.
 8. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 9. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway or Mineral-insulated, metal-sheathed cable, Type MI.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway, Metal-clad cable, Type MC or Mineral-insulated, metal-sheathed cable, Type MI.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. VFC Output Circuits: Type TC-ER cable with braided shield.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- B. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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 grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency and testing agency's field supervisor.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Burndy; Part of Hubbell Electrical Systems.
 2. ERICO International Corporation.
 3. Galvan Industries, Inc.; Electrical Products Division, LLC.
 4. Harger Lightning & Grounding.
 5. ILSCO.
 6. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 7. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

- D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- E. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare, tinned copper, not less than No. 8 AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. For grounding electrode system, install at least two rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- G. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Manhole Grounds: 10 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Hangers.
 - b. Steel slotted support systems.
 - c. Trapeze hangers.
 - d. Clamps.
 - e. Turnbuckles.
 - f. Sockets.
 - g. Eye nuts.
 - h. Saddles.
 - i. Brackets.
 - 2. Include rated capacities and furnished specialties and accessories.
- B. Delegated-Design Submittal: For hangers and supports for electrical systems.
 - 1. Include design calculations and details of trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M.
 - 2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation, A Member of the ABB Group.
 - f. Unistrut; an Atkore International company.
 - 2. Material: Galvanized steel.
 - 3. Channel Width: 1-5/8 inches.
 - 4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.
- B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMTs, IMCs, and RMCs may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

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. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Surface raceways
 - 5. Boxes, enclosures, and cabinets.
 - 6. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit.
 3. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 4. Republic Conduit.
 5. Southwire Company.
 6. Thomas & Betts Corporation, A Member of the ABB Group.
 7. Western Tube and Conduit Corporation.
 8. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. FMC: Comply with UL 1; zinc-coated steel.
- G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 2. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Compression.
 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- I. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Arcco Corporation.
 - 3. CANTEX INC.
 - 4. CertainTeed Corporation.
 - 5. Kraloy.
 - 6. RACO; Hubbell.
 - 7. Thomas & Betts Corporation, A Member of the ABB Group.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. MonoSystems, Inc.
 - 4. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. MonoSystems, Inc.
 - c. Legrand/Wiremold
 - d. Panduit

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper Technologies Company.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman; a brand of Pentair Equipment Protection.
 - 5. Hubbell Incorporated.
 - 6. MonoSystems, Inc.
 - 7. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 - 8. RACO; Hubbell.
 - 9. Thomas & Betts Corporation, A Member of the ABB Group.
 - 10. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Metal Floor Boxes:
 - 1. Material: Cast metal or sheet metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.

4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- K. Gangable boxes are allowed.
- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- M. Cabinets:
 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.
 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Oldcastle Precast, Inc.
 - e. Quazite: Hubbell Power Systems, Inc.
 - f. Synertech Moulded Products.
 2. Standard: Comply with SCTE 77.
 3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 6. Cover Legend: Molded lettering, "ELECTRIC."
 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.7 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC or IMC.

2. Concealed Conduit, Aboveground: GRC or IMC.
 3. Underground Conduit: RNC, Type EPC-40-PVC or Type EPC-80-PVC.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following:
 - a. Loading dock.
 - b. Mechanical rooms.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: GRC or IMC.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. EMT: Use compression, steel or cast-metal fittings. Comply with NEMA FB 2.10.
 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings.
- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from RNC, Type EPC-40-PVC to GRC or IMC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

- O. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- Q. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- R. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- S. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- T. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- U. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC in damp or wet locations not subject to severe physical damage.
- W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
- X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- Z. Locate boxes so that cover or plate will not span different building finishes.
- AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- CC. Set metal floor boxes level and flush with finished floor surface.
- 3.3 INSTALLATION OF UNDERGROUND CONDUIT
- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
 2. Install backfill as specified in Section 312000 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
- 2. Sleeve-seal systems.
- 3. Sleeve-seal fittings.
- 4. Grout.
- 5. Silicone sealants.

- B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:

- 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
- 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. HOLDRITE.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

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. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.

- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- B. Raceways and Cables Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- C. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.3 LABELS

- A. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Champion America.
 - c. emedco.
 - d. Grafoplast Wire Markers.
 - e. LEM Products Inc.
 - f. Marking Services, Inc.

- g. Panduit Corp.
 - h. Seton Identification Products.
- B. Snap-Around Labels for Raceways and Cables Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters of raceways they identify, and that stay in place by gripping action.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Marking Services, Inc.
 - c. Panduit Corp.
 - d. Seton Identification Products.
- C. Self-Adhesive Labels:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. A'n D Cable Products.
 - b. Brady Corporation.
 - c. Brother International Corporation.
 - d. emedco.
 - e. Grafoplast Wire Markers.
 - f. Ideal Industries, Inc.
 - g. LEM Products Inc.
 - h. Marking Services, Inc.
 - i. Panduit Corp.
 - j. Seton Identification Products.
 - 2. Preprinted, 3-mil-thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.
 - a. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized to fit the cable or raceway diameter, such that the clear shield overlaps the entire printed legend.
 - 3. Polyester or Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
 - a. Nominal Size: 3.5-by-5-inch.
 - 4. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 5. Marker for Tags: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

2.4 BANDS AND TUBES:

- A. Snap-Around, Color-Coding Bands for Raceways and Cables: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters of raceways or cables they identify, and that stay in place by gripping action.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Marking Services, Inc.
 - c. Panduit Corp.

- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around cables they identify. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Panduit Corp.

2.5 TAPES AND STENCILS:

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Carlton Industries, LP.
 - b. Champion America.
 - c. Ideal Industries, Inc.
 - d. Marking Services, Inc.
 - e. Panduit Corp.

- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.

- b. Carlton Industries, LP.
 - c. emedco.
 - d. Marking Services, Inc.

- C. Tape and Stencil for Raceways Carrying Circuits 600 V or Less: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. LEM Products Inc.
 - b. Marking Services, Inc.
 - c. Seton Identification Products.

- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Carlton Industries, LP.
 - b. Seton Identification Products.

- E. Underground-Line Warning Tape
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Ideal Industries, Inc.
 - c. LEM Products Inc.
 - d. Marking Services, Inc.
 - e. Reef Industries, Inc.
 - f. Seton Identification Products.
 - 2. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 3. Color and Printing:

- a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
4. Tag:
- a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - b. Width: 3 inches.
 - c. Overall Thickness: 5 mils.
 - d. Foil Core Thickness: 0.35 mil.
 - e. Weight: 28 lb/1000 sq. ft..
 - f. Tensile according to ASTM D 882: 70 lbf and 4600 psi.
- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 Tags

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. emedco.
 - d. Marking Services, Inc.
 - e. Seton Identification Products.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. emedco.
 - d. Grafoplast Wire Markers.

- e. LEM Products Inc.
- f. Marking Services, Inc.
- g. Panduit Corp.
- h. Seton Identification Products.

C. Write-On Tags:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Carlton Industries, LP.
 - b. LEM Products Inc.
 - c. Seton Identification Products.
2. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to raceway, conductor, or cable.
3. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 Signs

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches.
4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Carlton Industries, LP.
 - b. Champion America.
 - c. emedco.
 - d. Marking Services, Inc.

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.
4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Brady Corporation.
- b. Champion America.
- c. emedco.
- d. Marking Services, Inc.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
 - a. For signs up to 20 sq. inches, minimum 1/16-inch-
 - b. For signs larger than 20 sq. inches, 1/8 inch thick.
 - c. Engraved legend with black letters on white face.
 - d. Punched or drilled for mechanical fasteners.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. emedco.
 - d. Marking Services, Inc.

2.8 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Ideal Industries, Inc.
 2. Marking Services, Inc.
 3. Panduit Corp.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black, except where used for color-coding.
- C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black.
- D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F according to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F.
 5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

- G. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- I. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.
- J. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- K. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- L. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

3.3 IDENTIFICATION SCHEDULE

- A. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Snap-around labels. Install labels at 10-foot maximum intervals.
- B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.
- C. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels containing the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "STANDBY POWER."
 - 2. "POWER."
 - 3. "UPS."
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

- a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- E. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.
- F. Install instructional sign, including the color code for grounded and ungrounded conductors using adhesive-film-type labels.
- G. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.
- H. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive, self-laminating polyester labels with the conductor designation.
- I. Conductors To Be Extended in the Future: Attach marker tape to conductors and list source.
- J. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker-tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- K. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- L. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Metal-backed, butyrate warning signs.
1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
 4. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- N. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- O. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- P. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine plastic label, punched or drilled for mechanical fasteners. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless labels are provided with self-adhesive means of attachment, fasten them with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment To Be Labeled:

- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Switchboards.
- e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- f. Emergency system boxes and enclosures.
- g. Enclosed switches.
- h. Enclosed circuit breakers.
- i. Enclosed controllers.
- j. Variable-speed controllers.
- k. Push-button stations.
- l. Transfer Switches.
- m. Contactors.
- n. Remote-controlled switches, dimmer modules, and control devices.
- o. Battery-inverter units.
- p. Power-generating units.
- q. Monitoring and control equipment.
- r. UPS equipment.

END OF SECTION 260553

SECTION 262726

WIRING DEVICES

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. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. USB charger devices.
 - 3. Twist-locking receptacles.
 - 4. Weather-resistant receptacles.
 - 5. Snap switches.
 - 6. Pendant cord-connector devices.
 - 7. Cord and plug sets.
 - 8. Floor service outlets and poke-through assemblies.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- C. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.
 - 2. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
 - 2. Hubbell Incorporated; Wiring Device-Kellems.
 - 3. Leviton Manufacturing Co., Inc.
 - 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

2.3 USB CHARGER DEVICES

- A. Tamper-Resistant, USB Charger Receptacles: 12 V dc, 2.0 A, USB Type A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
 3. USB Receptacles: Dual, Type A.
 4. Line Voltage Receptacles: Dual, two pole, three wire, and self-grounding.

2.4 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration as indicated on drawings, and UL 498.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

2.5 PENDANT CORD-CONNECTOR DEVICES

- A. Description:
1. Matching, locking-type plug and receptacle body connector.
 2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
 3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
 4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 DECORATOR-STYLE DEVICES

A. Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

B. GFCI, Feed-Through Type, Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and UL 943 Class A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

C. GFCI, Weather-Resistant Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and UL 943 Class A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Pass & Seymour/Legrand (Pass & Seymour).

- D. Toggle Switches, Square Face, 120/277 V, 20 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
- E. Lighted Toggle Switches, Square Face, 120 V, 20 A: Comply with NEMA WD 1 and UL 20.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 - 2. Description: With neon-lighted handle, illuminated when switch is "off."
- F. All branch circuits rated at 15 amperes shall only have receptacles rated at 15 amperes connected to it.

2.8 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.9 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.

- C. Service Plate: Rectangular, solid brass with satin finish.
- D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

2.10 POKE-THROUGH ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Pass & Seymour/Legrand (Pass & Seymour).
 - 3. Square D; by Schneider Electric.
 - 4. Thomas & Betts Corporation, A Member of the ABB Group.
 - 5. Wiremold / Legrand.
- B. Description:
 - 1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
 - 2. Comply with UL 514 scrub water exclusion requirements.
 - 3. Service-Outlet Assembly: Pedestal type with services indicated.
 - 4. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
 - 5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 - 6. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
 - 7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables.

2.11 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
 - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262813

FUSES

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. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Switchboards.
 - c. Enclosed controllers.
 - d. Enclosed switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles. Include the following for each fuse type indicated:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 2. Coordination charts and tables and related data.
 - 3. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures," include the following:
 - 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann; a division of Cooper Industries.
 - 2. Edison; a brand of Cooper Bussmann; a division of Cooper Industries.
 - 3. Littelfuse, Inc.
 - 4. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 2. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting.
 - 3. Type J: 600-V, zero- to 600-A rating, 200 kAIC.
 - 4. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Service Entrance: Class L, time delay.
 - 2. Feeders: Class RK1, time delay.
 - 3. Motor Branch Circuits: Class RK1, time delay.
 - 4. Power Electronics Circuits: Class J, high speed.
 - 5. Other Branch Circuits: Class J, fast acting.
 - 6. Control Transformer Circuits: Class CC, time delay, control transformer duty.
 - 7. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

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Construction Documents

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END OF SECTION 262813

SECTION 263213

DIESEL ENGINE GENERATORS

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. This Section includes packaged engine-generator sets for emergency power supply with the following features:
 - 1. Diesel engine.
 - 2. Unit-mounted cooling system.
 - 3. Unit-mounted control and monitoring.
 - 4. Performance requirements for sensitive loads.
 - 5. Critical Silencer.
 - 6. Sound Attenuated Enclosure.
 - 7. Sub Base Fuel Tank.
- B. Related Sections include the following:
 - 1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.

- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 - 4. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Qualification Data: For installer manufacturer and testing agency.
- C. Source quality-control test reports.
 - 1. Certified summary of prototype-unit test report.
 - 2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
 - 3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
 - 4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
 - 5. Report of sound generation.

6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

- D. Field quality-control test reports.
- E. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 1. Maintenance Proximity: Not more than [four] hours' normal travel time from Installer's place of business to Project site.
 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with ASME B15.1.
- E. Comply with NFPA 20.
- F. Comply with NFPA 37.
- G. Comply with NFPA 70.
- H. Comply with NFPA 99.
- I. Comply with NFPA 110 requirements for Level [1] emergency power supply system.
- J. Comply with UL 2200.

- K. Comply with UL142
- L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- M. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify owner no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without owner's written permission.
- B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 to plus 40 deg C.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet

1.9 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof curbs, equipment supports, and roof penetrations for remote radiators. These items are specified in Division 07 Section "Roof Accessories."

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of startup including parts and labor for the entire 5 year period.

1.11 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Generac Model SD350.
- B. Subject to compliance with requirements, provide the basis of design product or a comparable product by one of the following:
 1. Kohler
 2. Cummins

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- C. Capacities and Characteristics:
 1. Power Output Ratings: As indicated on drawings
 2. Output Connections: Three-phase, four wire.
 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

E. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
 - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load

- current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
 - a. Provide permanent magnet excitation for power source to voltage regulator.
 10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

- A. Fuel: No. 2 ultra low sulfur diesel
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.
- D. Lubrication System: The following items are mounted on engine or skid:
 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
 1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
 1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.

3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
 - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
 1. Minimum sound attenuation of 25 dB at 500 Hz.
 2. Sound level measured at a distance of 10 feet from exhaust discharge after installation is complete shall be 85 dBA or less.
- J. Starting System: 12V or 24V electric, with negative ground.
 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified
 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
 7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
 8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to

- a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
- b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
- c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
- d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
- e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. AC frequency meter.
 - 4. DC voltmeter (alternator battery charging).
 - 5. Engine-coolant temperature gage.

6. Engine lubricating-oil pressure gage.
 7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator-voltage adjusting rheostat.
 10. Generator overload.
- E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- F. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."
- G. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
1. Overcrank shutdown.
 2. Coolant low-temperature alarm.
 3. Control switch not in auto position.
 4. Battery-charger malfunction alarm.
 5. Battery low-voltage alarm.
- H. Remote Alarm Annunciator: Comply with NFPA 99 & 110. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
- I. Remote Emergency-Stop Switch: Supplied in a break-glass type enclosure unless otherwise indicated; and labeled. Button shall be protected from accidental operation.

2.5 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Comply state & local AHJ requirements.
- C. Base-Mounted Fuel Oil Tank: Factory installed and piped, double wall, complying with UL 142 fuel oil tank. Features include the following:
1. Tank level indicator.
 2. Capacity: 24hr runtime at 100% load, but not to exceed requirements of authorities having jurisdiction.
 3. Containment & Overfill Prevention Provisions: Comply with requirements of authorities having jurisdiction.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, LSI electronic trip, complying with UL 489.
 - 1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 - 2. Trip Settings: Selected to coordinate with generator thermal damage curve.
 - 3. Mounting: Adjacent to or integrated with control and monitoring panel.
- B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
 - 1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 - 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
 - 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
 - 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
- C. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Provide PMG Excitation.
- C. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- D. Electrical Insulation: Class H.
- E. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

- G. Enclosure: Dripproof.
- H. Instrument Transformers: Mounted within generator enclosure.
- I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
 - 1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
- B. Description: Sound attenuated acoustic weather enclosure with the following features:
 - 1. Construction: Steel or Aluminum
 - 2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.
 - 3. Space Heater: Thermostatically controlled and sized to prevent condensation.
 - 4. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
 - 5. Hinged Doors: With padlocking provisions.
 - 6. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
 - 7. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
 - 8. Noise Level not to exceed 75dBA at 7meters
- C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
- D. Convenience Outlets: Factory wired GFCI. Arrange for external electrical connection.
- E. Load Center: Provide factory wired common connection point for all generator auxiliary loads.

2.9 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Full load run.
 - 3. Maximum power.
 - 4. Voltage regulation.
 - 5. Transient and steady-state governing.
 - 6. Single-step load pickup.
 - 7. Safety shutdown.
 - 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
 - 9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

- C. Install packaged engine generator with seismically rated restrained spring isolators. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."
 - 1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Division 23 Section "Hydronic Piping."
- E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
- F. Grounding: When 4 pole transfer switches are shown, bond generator neutral to ground for a separately derived system.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- C. Connect engine exhaust pipe to engine with flexible connector.
- D. Connect fuel piping to engines with a gate valve and union and flexible connector.
 - 1. Diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in Division 23 Section "Facility Fuel-Oil Piping."
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection (except those indicated to be optional) for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 - 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 - 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 - 6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
 - 7. Exhaust Emissions Test: Comply with applicable government test criteria.
 - 8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
 - 9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line and compare measured levels with required values.
 - D. Coordinate tests with tests for transfer switches and run them concurrently.
 - E. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
 - F. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - I. Remove and replace malfunctioning units and retest as specified above.
 - J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
 - K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.
 - L. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
- 3.6 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. The training shall consist of two (2) 4 hour sessions. Coordinate generator training with ATS training.

END OF SECTION 263213

SECTION 263600
TRANSFER SWITCHES

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. This Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and testing agency.
- B. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

- a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Features and operating sequences, both automatic and manual.
 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- E. Comply with NEMA ICS 1.
- F. Comply with NFPA 70.
- G. Comply with NFPA 99.
- H. Comply with NFPA 110.
- I. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
 - 1. Notify owner no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without owner's written permission.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Contactor Transfer Switches:
 - a. Generac Power Systems
 - b. ASCO Power Technologies
 - c. Russelectric

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.
 - 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- H. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.
- I. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
- J. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for RS485 capability for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- K. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- L. Enclosures: General-purpose NEMA 250, Type 1 complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- E. Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- F. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.
- G. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
- H. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer for NEC 702 systems. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.
1. Controls shall be provided to switch from emergency to neutral position when fire pump is called for duty during a power outage. Switch shall automatically return to normal when utility power is restored. Coordinate necessary controls and installation with fire pump controller manufacturer.

- I. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.

- J. Automatic Transfer-Switch Features:
 1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
 10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
 11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
 12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
 13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates

exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

- a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
- b. Push-button programming control with digital display of settings.
- c. Integral battery operation of time switch when normal control power is not available

2.4 CONTROL PANEL

- A. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.
- B. The controller shall direct the operation of the transfer switch. The controller's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, inherent serial communications capability, and the ability to communicate via the Ethernet through optional communications module
- C. A single controller shall provide single and three phase capability for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to $\pm 1\%$ of nominal voltage. Frequency sensing shall be accurate to $\pm 0.1\text{Hz}$. Time delay settings shall be accurate to $\pm 0.5\%$ of the full scale value of the time delay. The panel shall be capable of operating over a temperature range of -20 to $+70$ degrees C, and storage from -55 to $+85$ degrees C.
- D. The controller shall be enclosed with a protective cover and be mounted separate from the transfer switch unit for safety and ease of maintenance. Sensing and control logic shall be provided on printed circuit boards.
- E. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
 1. IEC 60947 – 6 – 1 Multiple Function Equipment Transfer Switching Equipment.
 2. IEC 61000 – 4 - 2 Electrostatic Discharge Immunity
 3. IEC 61000 – 4 - 3 Radiated RF Field Immunity
 4. IEC 61000 – 4 - 4 Electrical Fast Transient/Burst Immunity
 5. IEC 61000 – 4 - 5 Surge Immunity
 6. IEC 61000 – 4 – 6 Conducted RF Immunity
 7. CISPR 11 – Conducted RF Emissions and Radiated RF Emissions
- F. Controller shall be mounted on, visible, and operational through enclosure door

- G. A 128*64 graphical LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through communications port. The following parameters shall only be adjustable via DIP switches on the controller.
- H. Communications Module – Shall provide remote interface module to support monitoring of vendor’s transfer switch, controller and optional power meter. Module shall provide status, analog parameters, event logs, equipment settings & configurations over embedded webpage and open protocol. Features shall include:
1. Email notifications and SNMP traps of selectable events and alarms may be sent to a mobile device or PC.
 2. Modbus TCP/IP, SNMP, HTTP, SMTP open protocols shall be simultaneously supported.
 3. Web app interface requiring user credentials to monitor and control the transfer switch supporting modern smart phones, tablets and PC browsers. User will be able to view the dynamic one-line, ATS controls status, alarms, metering, event logging as well as settings.
 4. Secure access shall be provided by requiring credentials for a minimum of 3 user privilege levels to the web app, monitor (view only), control (view and control) and administrator (view, control and change settings). 128-Bit AES encryption standard shall be supported for all means of connectivity.
 5. Shall allow for the initiating of transfers, retransfers, bypassing of active timers and the activating/deactivating of engine start signal shall be available over the embedded webpage and to the transfer switch vendor’s monitoring equipment.
 6. An event log displaying a minimum of three-hundred (300) events shall be viewable and printable from the embedded webpages and accessible from supported open protocols.
 7. Four (4) 100 Mbps Ethernet copper RJ-45 ports, two (2) serial ports, and LEDs for diagnostics.
 8. DIN rail mountable.

This option shall be equivalent to ASCO accessory 72EE

2.5 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Retain paragraph below for floor-mounting switches and coordinate with Drawings.

- B. Identify components according Contract Documents.
- C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Contract Documents.
- C. Connect wiring according to Contract Documents.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
 - 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 - 5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

- a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
- a. Verify grounding connections and locations and ratings of sensors.
- D. Testing Agency's Tests and Inspections:
1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.

- f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
 - 5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- E. Coordinate tests with tests of generator and run them concurrently.
- F. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- G. Remove and replace malfunctioning units and retest as specified above.
- H. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment. The training shall consist of two (2) 4 hour sessions.
- B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Drawings
 - 1. "T" Drawings – Technology Plans
- C. Related Sections:
 - 1. Section 26 05 33 – "Raceways and Boxes for Electrical Systems"
 - 2. Section 27 05 44 – "Sleeves and Sleeve Seals for Communications Pathways and Cabling"
 - 3. Section 27 11 00 – "Communications Equipment Rooms"
 - 4. Section 27 15 00 – "Communication Horizontal Cabling"
 - 5. Section 27 51 16 – "Public Address System"
 - 6. Section 27 53 13 – Clock

1.02 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Optical-fiber-cable pathways and fittings.
 - 4. Metal wireways and auxiliary gutters.
 - 5. Nonmetallic wireways and auxiliary gutters.
 - 6. Surface pathways.
 - 7. Boxes, enclosures, and cabinets.
 - 8. Handholes and boxes for exterior underground cabling.

1.03 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of pathway groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, equipment racks and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.
- D. Source quality-control reports.

PART 2 - PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 3. Alpha Wire Company.
 4. Anamet Electrical, Inc.
 5. Electri-Flex Company.
 6. O-Z/Gedney; a brand of EGS Electrical Group.
 7. Picoma Industries; Subsidiary of Mueller Water Products, Inc.
 8. Republic Conduit.
 9. Robroy Industries.
 10. Southwire Company.
 11. Thomas & Betts Corporation.
 12. Western Tube and Conduit Corporation.
 13. Wheatland Tube Company; a division of John Maneely Company.
- B. General Requirements for Metal Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 3. Anamet Electrical, Inc.
 4. Arnco Corporation.
 5. CANTEX Inc.
 6. CertainTeed Corp.
 7. Condux International, Inc.
 8. Electri-Flex Company.
 9. Kraloy.
 10. Lamson & Sessions; Carlon Electrical Products.
 11. Niedax-Kleinhuis USA, Inc.
 12. RACO; a Hubbell company.
 13. Thomas & Betts Corporation.
- B. General Requirements for Nonmetallic Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.
- C. RNC: Type EPC-40-PVC complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Rigid HDPE: Comply with UL 651A.
- E. Continuous HDPE: Comply with UL 651B.
- F. RTRC: Comply with UL 1684A and NEMA TC 14.
- G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

- H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- I. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.03 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alpha Wire Company.
 - 2. Arnco Corporation.
 - 3. Endot Industries Inc.
 - 4. IPEX.
 - 5. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible-type pathway, approved for plenum installation unless otherwise indicated.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.

2.04 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman; a Pentair company.
 - 3. Mono-Systems, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250 and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.05 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Allied Moulded Products, Inc.
 - 2. Hoffman; a Pentair company.
 - 3. Lamson & Sessions; Carlon Electrical Products.
 - 4. Niedax-Kleinhuis USA, Inc.
- B. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.06 SURFACE PATHWAYS

- A. General Requirements for Surface Pathways:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.

- B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mono-Systems, Inc.
 - b. Niedax-Kleinhuis USA, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.

- C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems Division.
 - b. Lamson & Sessions; Carlon Electrical Products.
 - c. Mono-Systems, Inc.
 - d. Panduit Corp.
 - e. Wiremold / Legrand.

2.07 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Adalet.
 - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 - 3. EGS/Appleton Electric.
 - 4. Erickson Electrical Equipment Company.
 - 5. Hoffman; a Pentair company.
 - 6. Hubbell Incorporated; Killark Division.
 - 7. Lamson & Sessions; Carlon Electrical Products.
 - 8. Milbank Manufacturing Co.
 - 9. Molex; Woodhead Brand.
 - 10. Mono-Systems, Inc.
 - 11. O-Z/Gedney; a brand of EGS Electrical Group.
 - 12. RACO; a Hubbell company.
 - 13. Robroy Industries.
 - 14. Spring City Electrical Manufacturing Company.
 - 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
 - 16. Thomas & Betts Corporation.
 - 17. Wiremold / Legrand.

- B. General Requirements for Boxes, Enclosures, and Cabinets:
 - 1. Comply with TIA-569-B.
 - 2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. Metal Floor Boxes:
 - 1. Material: Cast metal
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.
 - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Device Box Dimensions: as specified within the architectural drawings.
- K. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures:
 - a. Material: Plastic.
 - b. Finished inside with radio-frequency-resistant paint.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

PART 3 - EXECUTION

3.01 PATHWAY APPLICATION

- A. Indoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Damp or Wet Locations: GRC.
 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
 7. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: Plenum-type, optical-fiber-cable pathway.
 8. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- B. Minimum Pathway Size: 3/4-inch trade size. Minimum size for optical-fiber cables is 1 inch.
- C. Pathway Fittings: Compatible with pathways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use setscrew or compression, cast-metal fittings. Comply with NEMA FB 2.10.
- D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- E. Install surface pathways only where indicated on Drawings.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg.

3.02 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Pathways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from ENT to RNC, Type EPC-40-PVC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- R. Surface Pathways:
 - 1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 - 2. Install surface pathway with a minimum 2-inch radius control at bend points.
 - 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
 - 1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
 - 2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
- U. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service pathway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- W. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturers written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a rain tight connection between box and cover plate or supported equipment and box.
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

- BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- CC. Set metal floor boxes level and flush with finished floor surface.
- DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.04 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.05 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

****End of Section****

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SECTION 27 05 36

CABLE TRAY FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Drawings
 - 1. "T" Drawings – Technology Plans
- C. Related Sections:
 - 1. Section 27 05 28 – "Pathways for Communications Systems"
 - 2. Section 27 11 00 – "Communications Equipment Rooms"
 - 3. Section 27 15 00 – "Communication Horizontal Cabling"
 - 4. Section 27 51 16 – "Public Address System"

1.02 SUMMARY

- A. Section Includes:
 - 1. Ladder cable trays.
 - 2. Wire-basket cable trays.
 - 3. Single-rail cable trays.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of cable tray.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- C. Delegated-Design Submittal: For seismic restraints.
 - 1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.

2. Design Calculations: Calculate requirements for selecting seismic restraints.

D. Detail fabrication, including anchorages and attachments to structure and to supported cable trays

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
2. Vertical and horizontal offsets and transitions.
3. Clearances for access above and to side of cable trays.
4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

B. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.

B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
2. Component Importance Factor: 1.5.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.

1. Temperature Change: 120 deg F

2.02 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
 - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
- C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
 - 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
 - 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
 - 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.03 LADDER CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Chatsworth
 - 3. Wiremaid Products Division; Vutec Corporation.
- C. Description:
 - 1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
 - 2. Rung Spacing: 12 inches o.c.
 - 3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
 - 4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch width with radius edges.
 - 5. No portion of the rungs shall protrude below the bottom plane of side rails.
 - 6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
 - 7. Minimum Usable Load Depth: 6 inches.
 - 8. Straight Section Lengths: 10 feet except where shorter lengths are required to facilitate tray assembly.
 - 9. Width: 12 inches unless otherwise indicated on Drawings.
 - 10. Fitting Minimum Radius: 12 inches .
 - 11. Class Designation: Comply with NEMA VE 1.
 - 12. Splicing Assemblies: Bolted type using serrated flange locknuts.
 - 13. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.

14. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.04 WIRE-BASKET CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product of one of the following:
 1. Cooper B-Line, Inc.
 2. Chatsworth
 3. SnakeTray.
 4. Wiremaid Products Division; Vutec Corporation.
- C. Description:
 1. Configuration: Wires are formed into a standard 2-by-4-inch wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.
 2. Materials: High-strength-steel longitudinal wires with no bends.
 3. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
 4. Sizes:
 - a. Straight sections shall be furnished in standard 118-inch lengths.
 - b. Wire-Basket Depth: 12 inches wide.
 - c. Wire-Basket Depth: 4 wide or as required.
 5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
 6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
 7. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.

2.05 SINGLE-RAIL CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 1. Cooper B-Line, Inc.
 2. Chatsworth
 3. Wiremaid Products Division; Vutec Corporation.
- C. Description:

1. Configuration: Center rail with extruded-aluminum rungs arranged symmetrically about the center rail.
2. Construction: Aluminum rungs mechanically connected to aluminum center rail in at least two places, with ends finished to protect installers and cables.
3. Rung Spacing: 12 inches o.c.
4. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
5. Straight Section Lengths: 10 feet except where shorter lengths are required to facilitate tray assembly.
6. Width: 12 inches unless otherwise indicated on Drawings.
7. Support Point: Splice fittings shall be hanger support point.
8. Support Spacing: Support each section at midpoint. Support wall-mounted sections a maximum of one-sixth of the section length from each end.
9. Loading Depth: 4 inches
10. Maximum Loads: 50 lb/ft.
11. Unbalanced Loads: Maintain cable tray rungs within six degrees of horizontal under all loading conditions.
12. Splicing Assemblies: Bolted type using serrated flange locknuts.
13. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
14. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.
15. Splices and Connectors: Protect cables from edges of center rail and do not intrude into cable fill area.

2.06 MATERIALS AND FINISHES

A. Steel:

1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1008/A 1008M, Grade 33, Type 2.
2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
4. Finish: Electrogalvanized before fabrication.
 - a. Standard: Comply with ASTM B 633.
 - b. Hardware: Galvanized, ASTM B 633.
5. Finish: poxy-resin or Powder-coat enamel paint.
 - a. Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.
 - b. Epoxy-Resin Prime Coat: Cold-curing epoxy primer, MPI# 101.
 - c. Epoxy-Resin Topcoat: Epoxy, cold-cured, gloss, MPI# 77.
 - d. Hardware: Chromium-zinc plated, ASTM F 1136.
6. Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D 769.

B. Aluminum:

1. Materials: Alloy 6063-T6 according to ANSI H 35.1/H 35.1M for extruded components and Alloy 5052-H32] or Alloy 6061-T6 according to ANSI H 35.1/H 35.1M for fabricated parts.
2. Hardware: Chromium-zinc-plated steel, ASTM F 1136.
3. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

C. Stainless Steel:

1. Materials: Low-carbon, passivated, stainless steel, Type 304L or Type 316L, ASTM F 593 and ASTM F 594.
2. Hardware for Stainless-Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

2.07 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Covers: Ventilated-hat type made of same materials and with same finishes as cable tray.
- C. Barrier Strips: Same materials and finishes as for cable tray.
- D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.08 WARNING SIGNS

- A. Lettering: 1-1/2-inch high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."
- B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."

2.09 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA FG 1.

PART 3 - EXECUTION

3.01 CABLE TRAY INSTALLATION

- A. Install cable trays according to NEMA FG 1.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure.
- G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems."
- H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- J. Support bus assembly to prevent twisting from eccentric loading.
- K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- L. Locate and install supports according to NEMA FG 1. Do not install more than one cable tray splice between supports.
- M. Support wire-basket cable trays with center support hangers or trapeze hangers or wall brackets.
- N. Support center support hangers or trapeze hangers for wire-basket trays with 1/4-inch diameter rods.
- O. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- P. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA FG 1. Space connectors and set gaps according to applicable standard.
- Q. Make changes in direction and elevation using manufacturer's recommended fittings.
- R. Make cable tray connections using manufacturer's recommended fittings.
- S. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."

- T. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- U. Install cable trays with enough workspace to permit access for installing cables.
- V. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
- W. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.
- X. Clamp covers on cable trays installed outdoors with heavy-duty clamps.
- Y. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.02 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.03 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inches.
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and

support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.

- E. Tie MI cables down every 36 inches where required to provide a 2-hour fire rating and every 72 inches elsewhere.
- F. In existing construction, remove inactive or dead cables from cable trays.

3.04 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.05 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorquing in suspect areas.
 7. Check for improperly sized or installed bonding jumpers.
 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.
- B. Prepare test and inspection reports.

3.06 PROTECTION

- A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

****End of Section****

SECTION 27 05 44

SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Drawings
 - 1. "T" Drawings – Technology Plans
- C. Related Sections:
 - 1. Section 07 84 13 "Penetration Firestopping"
 - 2. Section 27 05 28 "Pathways for Communications Systems"
 - 3. Section 27 11 00 "Communications Equipment Rooms"
 - 4. Section 27 15 00 "Communication Horizontal Cabling"
 - 5. Section 27 51 16 "Public Address System"

1.02 SUMMARY

- A. Section Includes:
 - 1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.

1.03 ACTION SUBMITTALS

- A. Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.

C. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chamber.

PART 2 - PRODUCTS

2.01 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water-stop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board

C. Sleeves for Rectangular Openings:

1. Material: Galvanized-steel sheet.
2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.02 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.

- b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
2. Sealing Elements: EPDM or equivalent rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Carbon steel.
 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03 GROUT

- A. Description: Non-shrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength. Packaging: Premixed and factory packaged.

2.04 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position water-stop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms. Using grout, seal the space around outside of sleeve-seal fittings.

****End of Section****

SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOMS

PART 1 - GENERAL

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Drawings
 - 1. "T" Drawings – Technology Plans
- C. Related Sections:
 - 1. Section 07 84 13 – "Penetration Firestopping"
 - 2. Section 27 05 28 – "Pathways for Communications Systems"
 - 3. Section 27 05 36 – "Cable Trays for Communication Systems"
 - 4. Section 27 05 44 – "Sleeves and Sleeve Seals for Communications Pathways and Cabling".
 - 5. Section 27 15 00 – "Communication Horizontal Cabling"

1.02 SUMMARY

- A. Description
 - 1. The scope of work required as part of this project shall include (4) four existing Data Equipment Rooms throughout this school. These rooms currently have existing racks and cabinets. All supplemental work is described within the Technology plans.
- B. Section Includes:
 - 1. Telecommunications Mounting Devices.
 - 2. Backer boards.
 - 3. Telecommunications Equipment racks and cabinets.
 - 4. Telecommunications service entrance pathways.

5. Grounding and bonding.

1.03 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel not exceeding 6 inches in width.
- D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- E. LAN: Local Area Network.
- F. RCDD: Registered Communications Distribution Designer.
- G. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of a bottom without ventilation openings within integral or separate longitudinal side rails.
- H. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- I. "Project Manager" shall mean the Owner's appointed representative.
- J. "As Necessary" shall mean work which is required for completed construction, but is not necessarily shown or described in the Contract Documents.
- K. "As Required" shall mean work which is required for completed construction and is shown on the drawings or described in the project specification.
- L. "Install" shall mean to set in place complete with all mounting facilities and connections as required ready for normal use of service.
- M. "Substantial Completion" shall mean that the project is sufficiently complete to be utilized for its intended use as stated in the body of this written specification.
- N. "Conduit" shall include all fittings, sleeves, connections, hangers and other accessories related to such conduit.
- O. "Surface Metal Raceway" shall include all fittings, sleeves, connections, hangers and other accessories related to such raceway.

- P. "Concealed" shall mean hidden from sight, as in chases, furred spaces, shafts, fixed ceiling or embedded in construction.
- Q. "Exposed", shall mean not "concealed" as defined above.
- R. "Governmental" shall mean all municipal, state and federal government agencies.
- S. The words "Furnish", "Supply" and "Provide" shall mean purchase, deliver to the job site, protect and provide interim storage and install in accordance with manufacturer's specifications.
- T. Words "Approved Equal" shall mean any product which in the opinion of the Technology Consultant is equal in quality, arrangement, appearance, and performance to the product specified.
- U. "Cabling" shall mean cable assembly, raceway, conductors, fittings and any other necessary accessories to make a complete wiring system.
- V. "Product" shall mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.
- W. Words in the singular shall also mean and include the plural, wherever the context so indicates, and words in the plural shall mean the singular, wherever the context so indicates.
- X. "Contractor" refers to the bidding/installation Contractor responsible for furnishing and installation of all work indicated within this specification.

1.04 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Floor-mounted equipment racks and cabinets and cable pathways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: As-built drawings for communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.
- C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- D. Seismic Qualification Certificates: For floor-mounted racks, cabinets, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions. Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.06 QUALITY ASSURANCE

- A. Installation of products shall be performed in accordance with the Manufacturer's suggested Installation procedures.
- B. 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/NTS and/or Commercial Installer, Level 2.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician and/or Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Field Inspector: Currently registered by BICSI as RCDD and/or Commercial Installer, Level 2 to perform the on-site inspection.
- C. Telecommunications Pathways and Spaces shall comply with TIA-569-C.

- D. Grounding shall comply with ANSI-J-STD-607-A.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment racks, cabinets, frames or cable trays until spaces are enclosed, built-out and weather-tight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.08 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier/ Service Providers.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of the Voice equipment, LAN equipment, Security Equipment, PA and Master Clock equipment and all other systems that share space within the Telecommunication Equipment rooms.
- B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.01 PATHWAYS

- A. General Requirements: Comply with TIA-569-C.
- B. Cable Support: Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.
 - 1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
 - 2. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 3. Lacing bars, spools, J-hooks, and D-rings.
 - 4. Straps and other devices.

- C. Conduit and Boxes: are not within part of this section and shall be described within other sections of this bid document.

2.02 BACKBOARDS

- A. Not required as part of this project.
- ~~B. Backboards shall be furnished and installed as part of this specification and located on a minimum of 3 walls of the Data rooms.~~
- ~~C. Backboard sizes: 3/4 by 48 by 96 inches.~~
- ~~D. Plywood shall be fire retardant treated with (2) coats of black fire retardant paint.~~
- ~~E. Plywood shall comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."~~

2.03 EQUIPMENT FRAMES

- A. No supplemental equipment frames are required as part of this project unless specified within the Technology drawings or supplemental changes to this project. Should any of these devices be required, the following shall be maintained:
- B. The desired products are specified within the drawing documents. If an alternate is submitted, the alternate must conform with all characteristics of the specified product that is within the drawing documents.
- C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - 1. Great Lakes
 - 2. Chatsworth Products, Inc
 - 3. Middle Atlantic
- D. General Frame Requirements:
 - 1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 - 2. Module Dimension: Width compatible with EIA 310 standard, 19-inch panel mounting.
 - 3. 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. 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.

PART 3 - EXECUTION

3.01 COMMISSIONING OF SYSTEMS AND EQUIPMENT

- A. Engage a factory-authorized service representative or technician who is familiar with this project to participate and assist, if necessary, in the functional performance testing of the equipment include in this Division with the Commissioning Agent.

3.02 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Install underground pathways complying with recommendations in TIA-569-C.
- C. Install underground entrance pathway complying with Division 26 Section "Raceway and Boxes for Electrical Systems "INSTALLATION".

3.03 INSTALLATION

- A. Comply with NECA 1.
- B. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.04 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping." Comply with TIA-569-C.
- B. All conduits etc., passing through fire rated floors, walls and partitions, shall have the space between the raceways, sleeves and all penetrations filled with a reusable fire stopping material such as Firestop Putty, Adhesive Firestop Sealant or Firestop Compound as manufactured by STI or approved equal.

3.05 GROUNDING

- A. Comply with ANSI-J-STD-607-A.
- B. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.06 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements in Division 26 Section "Identification for Electrical Systems." Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- B. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion of TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2, Class 3, or Class 4 level of administration including optional identification requirements of this standard.
- C. Labels shall be preprinted or computer-printed type.

****End of Section****

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SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Drawings
 - 1. "T" Drawings – Technology Plans
- C. Related Sections:
 - 1. Section 27 05 28 – "Pathways for Communications Systems"
 - 2. Section 27 05 36 – "Cable Trays for Communication Systems"
 - 3. Section 27 05 44 – "Sleeves and Sleeve Seals for Communications Pathways and Cabling".
 - 4. Section 27 11 00 – "Communications Equipment Room"

1.02 SUMMARY

- A. Section Includes:
 - 1. Pathways.
 - 2. UTP cabling.
 - 3. Cable connecting hardware, patch panels, and cross-connects.
 - 4. Telecommunications outlet/connectors.
 - 5. Cabling system identification products.
 - 6. Cable management system.

1.03 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.

- C. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- E. EMI: Electromagnetic interference.
- F. IDC: Insulation displacement connector.
- G. Ladder Rack / Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs). LAN: Local area network.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. RCDD: Registered Communications Distribution Designer.
- J. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.
- K. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.
- L. UTP: Unshielded twisted pair.

1.04 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
 - 1. TIA-568-C.2 requires that a minimum of two telecommunications outlet/connectors be installed for each work area, unless otherwise specified within the drawing documents.
 - 2. Horizontal cabling shall contain no transition points or consolidation points between the horizontal cross-connect and the telecommunications outlet/connector.
 - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
 - 4. Splitters shall not be installed as part of the horizontal cabling.
- B. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation

equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

- C. If the installation contractor believes that any cabling will exceed the 295 feet, they are to make the technology consultant aware of this prior to installing the cable so that a remedy can be put in place. All cabling that is installed and exceeds the 295 feet, may be subject to be removed at the installation contractor's expense to attain a length less than 295 feet.

1.05 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.2, when tested according to test procedures of this standard.

1.06 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For coaxial cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- B. Manufacturer Warranty
 - 1. All test results for all Ethernet cabling shall be submitted to the manufacturer of the cabling and termination devices to attain the manufacturer's extended warranty.
 - 2. This procedure must be performed by the installation contractor.
- C. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.

- c. Patch cords.
 - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
 - D. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
 - E. Source quality-control reports.
 - F. Field quality-control reports.
 - G. Maintenance Data: For splices and connectors to include in maintenance manuals.
 - H. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
- 1.07 QUALITY ASSURANCE
- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 or less.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Telecommunications Pathways and Spaces: Comply with TIA-569-C.
- F. Grounding: Comply with ANSI-J-STD-607-A.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical loss test set.
 2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
 3. Test each pair of UTP cable for open and short circuits.

1.09 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

PART 2 - PRODUCTS

2.01 PATHWAYS

- A. General Requirements: Comply with TIA-569-C.
- B. Cable Support: NRTL labeled for support of Category 6 and 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- C. Ladder Rack / Cable Tray:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include and are limited to the following:
 - a. Great Lakes
 - b. Cooper B-Line, Inc.
 - c. Chatsworth Products
 - d. Snake Tray
 - 2. Ladder Rack Materials: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch thick.
 - a. Ladder Rack Trays: Nominally 12 inches wide, and a rung spacing of 12 inches.
 - b. Must be supported every 10' minimally.
- D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."

1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.02 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include and are limited to the following:
 1. Berk-Tek
 2. Superior Essex
 3. Belden
- B. Description: 100-ohm, 4-pair UTP, formed into 4-pair, binder groups covered with a blue plenum rated jacket.
 1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA-568-C.2 for performance specifications.
 3. Comply with TIA-568-C.2, Category 6.
 4. Comply with TIA-568-2.D, Category 6A.

2.03 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include and are limited to the following:
 1. Leviton
 2. Hubbell Premise Wiring
 3. Belen
- B. General Requirements for Cable Connecting Hardware: Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 5E. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated, plus spares and blank positions adequate to suit specified expansion criteria.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

2.04 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA-568-C.2, category 6.
Comply with TIA-568-2.D, Category 6A.
- B. Workstation Outlets: Multi-port-connector assemblies mounted in single-gang faceplate.
 - 1. Plastic Faceplate: As specified within the drawing documentation.
 - 2. For use with snap-in jacks accommodating any combination of UTP work area cords.
 - 3. Flush mounting jacks, positioning the cord at a 45-degree angle.
 - 4. Legend: Machine printed, in the field, using adhesive-tape label.
 - 5. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.05 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.06 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

- C. Labeling for all cabling and termination equipment is described within the drawing package.

2.07 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA-568-C.3.
- C. Factory test UTP cables according to TIA-568-C.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.02 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA-569-A-7.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA-569-C for pull-box sizing and length of conduit and number of bends between pull points.

- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.03 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C.2.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. MUTOA shall not be used as a cross-connect point.
 - 5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
 - 6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 12. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
 13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA-568-C.2.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.04 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA-569-C.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.05 IDENTIFICATION

- A. All labeling of workstation outlets and patch panels shall be described by the Owner prior to testing and labeling of these devices.

- B. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Administration Class: 2.
 - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- C. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- D. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- E. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration, including optional identification requirements of this standard.
- F. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- G. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA-606-B. Furnish electronic record of all drawings, in software and format selected by Owner.
- H. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.

4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
6. Labeling is described within drawing package.
 - I. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA-606-B.
 1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.06 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.2.
 2. Visually confirm Category 6 and 6A marking of outlets, cover plates, outlet/connectors, and patch panels.
 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2 for category 6 and 6A systems. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are

qualified by test equipment manufacturer for channel or link test configuration.

5. UTP Performance Tests:

a. Test for each workstation outlet. Perform the following tests according to TIA-568-C, category 6 and 6A standards:

- 1) Wire map.
- 2) Length (physical vs. electrical, and length requirements).
- 3) Insertion loss.
- 4) Near-end crosstalk (NEXT) loss.
- 5) Power sum near-end crosstalk (PSNEXT) loss.
- 6) Equal-level far-end crosstalk (ELFEXT).
- 7) Power sum equal-level far-end crosstalk (PSELFEXT).
- 8) Return loss.
- 9) Propagation delay.
- 10) Delay skew.

6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.

a. 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 digital subscription line telephone call.

b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

****End of Section****

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SECTION 27 41 16.51

AUDIO VIDEO SYSTEMS FOR CLASSROOMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Drawings:
 - 1. "T" Drawings – Technology Plans

1.02 SUMMARY

- A. Furnish and install sound, video, and communication systems as shown on drawings and as specified herein, complete with all apparatus, equipment, power supplies, wiring, labor, and services necessary to ensure a complete working system. Verify completeness of equipment listed and correctness of type numbers. Furnish and install supplementary equipment needed to meet system requirements, without claim for added payment. Labor furnished shall be specialized and experienced in systems installation.
- B. Interconnection from/to all devices and teachers station outlets, testing, all configurations and training are part of this section.
- C. All areas shall receive new cabling as specified.
- D. This work includes, but is not limited to the following:
 - 1. Furnish all back boxes and enclosures.
 - 2. Deliver to the job site all back boxes which are to be installed by others.
 - 3. Furnish and install all wire and cable.
 - 4. Furnish any additional items, not specifically mentioned herein, to meet system requirements as specified, without claim for additional payment. Such items may include hardware, transformers, line/distribution amplifiers, and other devices for proper installation, interface, isolation or gain structure.
 - 5. Submission of shop drawings prior to fabrication.
 - 6. Verification of dimensions and conditions at the job site.
 - 7. Installation in accordance with these specifications, manufacturer's recommendations, and all applicable code requirements.
 - 8. Setup and adjustment of signal processing, system tests and adjustments, written report, demonstration for approval, participation in acceptance tests, and final adjustments as required.
 - 9. Coordination with the Electrical Contractor is required to assure correct Systems conduit routing, Systems backbox locations, and clean power circuit locations as specified in Division 26 – Electrical.

10. Coordination with the Lighting Contractor
11. Coordination with the Fire Alarm Systems Contractor
12. Coordination with the Tel/Data Contractor and other Low Voltage Contractors
13. Coordination with the Owner's IT department and installers
14. Performance standards, without claim for additional payment
15. System Documentation
16. Instruction of owner's operating personnel
17. Maintenance and services for two years
18. Guarantee all equipment and components for the specified period from the date of acceptance.

E. All work described within this section must be coordinated with other trades to ensure a successful installation.

F. Section Includes

1. Interactive Whiteboards and accessories
2. Projectors and accessories
3. Speakers and accessories
4. Assistive Listening Systems and Devices
5. A/V Cabling

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: From approved manufacturer for each type of device required. Include plan view locations, elevations, installation details, and accessories.

1. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.

C. Product Data: Submit manufacturer's technical data, product specifications, installation instructions, and other pertinent information as applicable for each product or material specified.

D. Operating and Maintenance instructions for each product.

E. Samples of Manufacturer's standard and extended Warranties.

F. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation.

G. Operation and Maintenance Data: For Interactive Whiteboards, Projectors and speakers.

1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

1.04 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain all materials from one source from a single approved manufacturer for each different product required.
- B. Certification: CE, FCC Class A

1.05 Delivery, Storage and Handling

- A. Take care in handling products in accordance with manufacturer's instructions.
- B. Store indoors in original undamaged packaging, in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Store products upright in secure, protected area. Do not stack! Verify with manufacturer that site conditions are acceptable before receiving material.
- C. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
 - 1. Interior, Controlled Environment: System components installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of any device and equipment related to operation, and equipment that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Unless stated otherwise within product descriptions, a [Two] 2 year warranty from date of Substantial Completion shall be provided.
 - 2. Provide information on available extended warranties.

PART 2 - PRODUCTS

2.01 SPEAKERS AND MOUNTING HARDWARE

- A. The selected manufacturer shall be OWI – CA, USA. Other manufacturers will be considered, providing equipment meets or exceeds the quality specified and they can provide equipment of the type, size and function required. Substitutions must be approved by the Owner prior to this Bid Submission.
 - 1. All speakers, drop ceiling tile bridge and backcan must be provided for each speaker.
 - 2. Speakers Primary w/priority override:
 - a. The selected model shall be OWI #AMP-HDTR6
 - b. Priority override shall be OWI #AMP-POP1

3. Speakers Slave:
 - a. The selected model shall be OWI #IC6
 4. Drop ceiling tile bridge:
 - a. The selected model shall be OWI #6TB
 5. Back Can:
 - a. The selected model shall be OWI #BACKCAN
- B. Each classroom speaker package shall include the following peripheral devices. Refer to wiring diagram in plans for placement:
1. Hum Eliminator:
 - a. The selected model shall be OWI #AMP-HUM ELM
1) QTY (2) per OWI #AMP-HDTR6
 2. 25V Transformer, tap @1/2W:
 - a. The selected manufacturer shall be BOGEN or equiv.
1) QTY (1) per OWI #AMP-HDTR6
 3. Volume Control:
 - a. The selected model shall be OWI #MC4
1) QTY (Per Drawings)
 4. Wireless Pendant Microphone System:
 - a. The selected model shall be OWI #IR20REC-KIT
1) QTY (1) per #MC4
 5. Power Dongle for Microphone and Volume Control:
 - a. The selected model shall be OWI #MC4-DNGL
1) QTY (1) per #MC4
- C. All speakers and back cans must be properly supported to the structure separate from the ceiling grid and per all required code requirements.
- 2.02 ASSISTIVE LISTENING SYSTEMS:
- A. The selected manufacturer shall be OWI / Listen Technologies.
- B. Every classroom location notating an "Assistive Listening Transmitter" shall receive the following:
1. Assistive Listening Transmitter:
 - a. The selected model shall be OWI #OWI-KSTM-LT-84-KIT
1) QTY (per drawings)
 - b. The selected Remote Powering Supply kit shall be Listen Technologies #LPT-A117
 2. Assisted Listening Receiver & Neck Loop Lanyard:
 - a. The selected model shall OWI #LR-4200 IR-P1
- C. The following 12-Unit Charging Tray shall be delivered to the school upon completion of the project:
1. USB 4-PORT CHARGER
 - a. The selected model shall be Listen Technologies #LA-423
1) QTY (1) PER #OWI-KSTM-LT-84-KIT

2.03 TEACHER STATION AND PROJECTOR STATION AV INPUT/OUTPUT PLATES:

- A. The Teacher and Projector AV plates are designated as “A” and “A1” on plans.
- B. The VGA & 3.5mm over 110 Module listed below is sold in pairs. The transmitter (labeled PC) shall be installed in the “A” plate. The receiver (labeled DISPLAY) shall be installed in the “A1” plate.
- C. Refer to plans for backbox, mud-ring, and conduit requirements.
- D. Each Teacher Station AV plate (“A” plate on plans”) shall receive the following:
 - 1. QTY (1) HUBBELL #IMF2xx Faceplate – Confirm color with Architect.
 - 2. QTY(3) HUBBELL #IM1K1W Keystone Flat 1-Port Unit – Confirm color with Architect.
 - 3. QTY (2) HUBBELL #SFHC14 HDMI Female Connector
 - 4. QTY (1) HJX6G Cat 6 Green RJ45 Jack
 - 5. QTY (1) IMB10xx Blank Module – Confirm color with Architect.
 - 6. QTY (1) HUBBELL IM15311015W VGA & 3.5 Over 110 – Confirm color with Architect.
- E. Each Projector Station AV plate (“A1” plate on plans”) shall receive the following:
 - 1. QTY (1) HUBBELL #IMF2xx Faceplate – Confirm color with Architect.
 - 2. QTY(3) HUBBELL #IM1K1W Keystone Flat 1-Port Unit – Confirm color with Architect.
 - 3. QTY (2) HUBBELL #SFHC14 HDMI Female Connector
 - 4. QTY (1) HJX6G Cat 6 Green RJ45 Jack
 - 5. QTY (1) IMB10xx Blank Module – Confirm color with Architect.
 - 6. QTY (1) HUBBELL IM15311015W VGA & 3.5 Over 110 – Confirm color with Architect.

2.04 CABLING

- A. Audio Input Lines:
 - 1. Use cable with a foil shielded pair of stranded #22 AWG conductors, with a stranded shield drain wire. For single pair, use a miniature cable nominal outside diameter 0.135”. Use of a multi-pair cable is optional. Provide plenum rated equivalent as required.
 - a. Belden 8451
 - b. Mohawk 1671
 - c. West Penn 452
- B. Loudspeaker Wiring:
 - 1. Provide unshielded loudspeaker wiring for connection to loudspeakers and loudspeaker receptacles. For lines in rigid conduit or electrical tubing, use stranded or solid conductors. For lines in flexible conduit or electrical tubing and for all wiring to equipment within equipment racks, use only stranded conductors.
 - 2. Use color-coded #12 AWG conductors for all loudspeakers and except for 70 V ceiling-mounted loudspeakers and loudspeaker receptacles.
 - a. Belden 8477
 - b. West Penn 227

- c. Approved Equal
 3. For all ceiling-mounted loudspeaker wiring using 70 Volt lines provide color-coded #18 AWG loudspeaker wiring.
 - a. Belden 8461
 - b. West Penn 224
 - c. Approved Equal
 4. Use color-coded #14 AWG conductors for all loudspeaker receptacle wiring
 - a. Belden 8473
 - b. West Penn 226
- C. Category Wiring:
 1. Provide Category 6 8-conductor unshielded twisted pair cable with 23 AWG solid conductors and bandwidth of 250 Mhz for computer data and audio visual transport wiring.
 - a. Berk-Tek
 - b. Superior Essex
 - c. Belden
- D. HDMI Wiring:
 1. HDMI cable shall be FSR Digital Ribbon Cable #DR-PCB-HxxM.
 - a. Length of this cable must conform the length of the intended use.
- E. All Audio Visual and associated cabling required for each system specified within this document is to be furnished, installed, terminated and tested as part of this section.
- F. Wiring Method: Install cables in raceways unless otherwise indicated.
- G. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- H. Splices, Taps, and Terminations: For control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. This specification shall include all installation and setup labor and configuration of all devices to furnish a complete, efficient and effective system.
- B. All cables, connectors and peripheral equipment's required to attain a fully functional system shall be furnished, installed and performed by the contractor awarded this project.
- C. Locate all apparatus requiring adjustments, cleaning or similar attention so that it will be accessible for such attention.

- D. Furnish and install brackets, braces and supports. Minimum fastening or support safety factor shall be at least three (3). Design shall be to the approval of the Architect.
- E. Provide custom color or finish for any equipment or materials supplied which are exposed to public view. Color and finish of all such equipment or materials shall be approved in writing by the Architect. This does not exclude equipment or materials where standard colors and finishes may be specified herein.
- F. Switches, connectors, jacks, receptacles, outlets, cables and cable terminations shall be logically and permanently marked. Custom panel nomenclature shall be engraved, etched or screened. Markings for these items are detailed in the drawings to ensure consistency and clarity. Verify any changes in working type size and/or placement with the Systems Designer prior to marking.
- G. The equipment specified herein is designed to operate in environments of normal humidity, dust and temperature. Protect equipment and related wiring where extreme environmental conditions can occur.
- H. Secure equipment firmly in place, including control panels, loudspeakers, conduit, amplifiers, racks, and cables. Make fasteners and supports to support their loads with a safety factor of at least three.
- I. Take precautions to prevent electromagnetic and electrostatic hum. Install equipment to provide safe operation.
- J. Clearly, consistently, logically, and permanently mark connectors, jacks, relays, receptacles, cables, and cable terminations.
- K. All wall mounted devices shall be mounted, secured and installed in accordance with SEI/ASCE 7 and shall additionally withstand the effects of any motions within the building as determined by SEI/ASCE 7.
 - 1. The term "WITHSTAND" means "THE UNITS WILL REMAIN IN PLACE WITHOUT SEPARATION OF ANY PARTS FROM THE DEVICE WHEN SUBJECTED TO THE SEISMIC FORCES SPECIFIED AND THE UNIT WILL BE FULLY OPERATIONAL AFTER THE SEISMIC EVENT."

3.02 VERIFICATION TESTS

- A. Confirm that each individual wire and cable run is identified with a unique number. These numbers are affixed to both ends of each cable and are clearly visible. Provide a complete list of these numbers along with the termination location of each end of the wire run.
- B. Confirm that all system outputs are free of spurious signals including oscillations and radio frequency signals. A wide band oscilloscope shall be used to verify this condition.
- C. Confirm that the system is free of audible clicks, pops, and other noises when any operating control is activated, with or without input signal.
- D. For all microphone lines, tie lines, return lines and effect loudspeaker lines, confirm:

1. Proper circuits appearing at each termination location.
 2. Proper circuits appearing at each jack bay position.
 3. Continuity of all conductors.
 4. Proper polarity is maintained.
 5. Absence of shorts between conductors within each circuit.
 6. Absence of shorts between circuit conductors and conduit.
- E. Confirm that speakers and mountings are free of buzzes and rattles when the speaker is swept with sine wave tones over its rated bandwidth at one-half its maximum rated power.
- F. For each installed data network cable or fiber optic cable confirm conformance to the specified TIA/EIA performance standards.

3.03 GROUNDING

- A. Audio system wiring shall conform to the following procedures:
1. Audio equipment AC ground pins shall connect to AC isolated ground.
 2. Audio equipment chassis shall connect to AC isolated ground or rack frames.
 3. Audio shields between AC powered pieces of equipment shall be connected to ground at one end only. Capacitive terminate as required.
 4. Isolate all Systems wiring from racks, back boxes and conduit.
 5. AC isolated ground system shall be isolated from all other facility grounds.
- B. All metallic conduit, boxes and enclosures shall be grounded in accordance with the current National Electrical Code.
- C. Metallic enclosures containing active equipment shall be grounded with due regard for the minimization of electrical noise. This may include the provision of grounding conductors separate from the AC ground.

3.04 COMMISSIONING OF SYSTEMS AND EQUIPMENT

- A. Engage a factory-authorized service representative or technician who is familiar with this project to participate and assist, if necessary, in the functional performance testing of the equipment include in this Division with the Commissioning Agent.

3.05 EXAMINATION

- A. Examine room conditions, ceiling and wall surfaces to assure they are in compliance with requirements and other conditions affecting installation and operation of Interactive Whiteboards projectors and speakers.
- B. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to A/V cabling and other conditions affecting installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.06 FIELD QUALITY CONTROL

- A. Verify that accessories required for each unit have been properly installed.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
 - 2. Each Assisted Listening System must be tested with a field strength meter for proper telecoil strength.
 - 3. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements.
 - 4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation.

3.07 CLEANING

- A. Remove rubbish and debris: Installation contractor is not allowed you use the onsite dumpster and is responsible to discard their own debris off site.
- B. Clean installed items using methods and materials recommended in writing by manufacturer.

3.08 DEMONSTRATION

- A. Bidding contractor shall engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain each system described within this specification for the audio visual equipment. This training shall include (8) hours, in the blocks of hours that shall be described by the Owner.
- B. Upon approval of the above test report by the Architect and at a mutually agreeable time, demonstrate operation of each major component and of the complete installation. After demonstration, assist as required in acceptance testes.
- C. Listening Tests:
 - 1. Tests will include subjective evaluation by observers listening at various positions under various operating conditions of the system, intended to test its operation in conformance with its functional requirements.
- D. Equipment Tests:

1. Perform any measurements of frequency response, distortion, noise or other characteristics and any operational tests deemed necessary by the Architect to determine conformity with these requirements.
 2. If the need for adjustment or modification becomes evident during demonstration and testing, continue working until the installation operates properly.
 3. Perform testing to demonstrate the Priority Override Function from the Public Address system.
- E. Final Adjustments:
1. Make control adjustments as directed by the Architect. Make a record of these control settings. Provide covers, caps, or shaft locks for controls not used in system operation.

3.09 COMPLETION

- A. Warranty service shall commence from 2 years after acceptance. Warranty service shall be provided during standard business hours within 24 hours after notice of concern.
- B. Labor and materials provided under scope of project shall be covered under 2 year warranty. Devices shall be free of defects from installation of manufacturer. If an item requires replacement, this shall be provided at no additional cost to owner. If items are abused or rendered inoperable from mis-use they shall not be covered under said warranty.
- C. A/V integrator shall provide "As Built" documents, 2 sets, to owner. This shall include equipment list, as installed, equipment manuals, and detailed drawings showing as installed wiring details.
1. Provide a digital PDF copy of documentation on a USB Memory stick or CD/DVD for owner.
- D. Bidding contractor shall engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain each system described within this specification for the audio-visual equipment. This training shall include forty (8) hours, in the blocks of hours that shall be described by the Owner. These services shall be considered as part of the contract and at no additional fees charged to owner.

****End of Section****

6 August 2019
Construction Documents

Stamford Public Schools
Westover Magnet Elementary School
SPN 135-0278RR

SECTION 27 41 16.62

AUDIO VIDEO SPECIALTY ROOMS

PART 1 - GENERAL

1.01 Section Includes

- A. Gymnasium #144 Sound Reinforcement & Assistive Listening
- B. Cafeteria #255 Sound Reinforcement & Assistive Listening
- C. Auditorium #288 AV Reproduction & Electric Screen

1.02 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within Division 01 – GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. Examine all other Sections of the Specifications for requirements that affect work of this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all other trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.
- D. The contractor awarded this project is responsible for the following:
 - 1. Removing the existing auditorium projector and screen and delivering to the owner
 - 2. Extending the audio feed from the new projector to the existing sound system. The audio shall be integrated into the existing speaker system for a fully functional system.

1.03 EXAMINATION OF SITE AND DOCUMENTS

- A. The Trade Contractor for this Section shall examine all Drawings and all Sections of the Specification for requirements therein that may affect the Work of this Section, not just those Drawings and Specifications particular to the Work of this Section. The Work of this Section is shown primarily on the following listed Drawings:
 - 1. Architectural
 - 2. Electrical
 - 3. Technology
 - 4. Theater
 - 5. Audiovisual
 - 6. Fire Protection
- B. Bidders are expected to examine and be thoroughly familiar with all contract documents and with the conditions under which work will be carried out. The Awarding

Authority (Owner) will not be responsible for errors, omissions, and/or charges for extra work arising from General Contractor's or Trade Contractor's failure to familiarize themselves with the Contract Documents or existing conditions. By submitting a bid, the Bidder agrees and warrants that he has had the opportunity to examine the site and the Contract Documents, that he is familiar with the conditions and requirements of both and where they require, in any part of the work a given result to be produced, that the Contract Documents are adequate and that he will produce the required results.

1.04 RELATED DOCUMENTS

- A. Refer to AE and AV drawings and project architectural, structural and electrical drawings for information related to the work specified herein.
- B. Related Drawings:
 - 1. T – Technology Drawings

1.05 SCOPE OF WORK

- A. Furnish and install sound, video and communication systems as shown on drawings and as specified herein, complete with all apparatus, equipment, power supplies, wiring, labor, and services necessary to ensure a complete working system. Verify completeness of equipment listed and correctness of type numbers. Furnish and install supplementary equipment needed to meet system requirements, without claim for added payment. Labor furnished shall be specialized and experienced in Systems installation.
- B. This work includes, but is not limited to the following:
 - 1. Furnish all back boxes and enclosures.
 - 2. Deliver to the job site all back boxes which are to be installed by others.
 - 3. Furnish and install all wire and cable.
 - 4. Furnish any additional items, not specifically mentioned herein, to meet system requirements as specified, without claim for additional payment. Such items may include hardware, transformers, line/distribution amplifiers, and other devices for proper installation, interface, isolation or gain structure.
 - 5. Submission of shop drawings prior to fabrication.
 - 6. Verification of dimensions and conditions at the job site.
 - 7. Installation in accordance with these specifications, manufacturer's recommendations, and all applicable code requirements.
 - 8. Setup and adjustment of signal processing, system tests and adjustments, written report, demonstration for approval, participation in acceptance tests, and final adjustments as required.
 - 9. Programming and documenting of all software controlled devices including initial setup of presets in all devices.
 - 10. Coordination with the Electrical Contractor is required to assure correct Systems conduit routing, Systems backbox locations, and clean power circuit locations as specified in Division 26 – Electrical.
 - 11. Coordination with the Lighting Contractor

12. Coordination with the Fire Alarm Systems Contractor
13. Coordination with the Tel/Data Contractor and other Low Voltage Contractors
14. Coordination with the Owner's IT department and installers
15. Performance standards, without claim for additional payment
16. System Documentation
17. Instruction of owner's operating personnel
18. Maintenance and services for one year
19. Guarantee all equipment and components for the specified period from the date of acceptance.

- C. All work described within this section must be coordinated with other trades to ensure a successful installation.

1.06 CONTRACTOR RESPONSIBILITY

- A. Specification drawings are detailed only to the extent necessary to show design intent and signal flow. It is understood and agreed by the Contractor that the work herein described shall be complete in every detail to supply a complete working system.
- B. Equipment not mentioned herein nor shown on Drawings but necessary to meet this requirement shall be provided without claim for additional payment.

1.07 SUBMITTALS

A. Pre-Bid Submittals

1. All Contractors submitting bids for the Systems within this section must be qualified by the Systems Designer.
2. Not later than ten (10) days prior to the bid date, Contractor shall submit to the Systems Designer for approval, brochures containing a statement of the Contractor's qualifications. At minimum this submittal shall include the following:
 - a. A list of systems of comparable size and scope to that described herein, completed by the Contractor in the last five (5) years that include DSP devices of the same quality. Indicate the project name and address, year of completion, and the name and phone number of a person to contact who is representative of the Owner or User.
 - b. A personal resume of formal education and experience of the staff member who would act as Leader for the Project.
 - c. A description of the Contractor's capabilities and facilities for generating CAD (or other high quality graphics) documentation for the Shop Drawings and As-Built Drawings.
 - d. Provide a statement from the major manufacturers showing the sound contractor is an authorized representative of that product. This is to ensure products are current, recall notices are acknowledged, and correct programming/installation methods are employed as recommended by the manufacturer.

B. Bid Submittals

1. Contractors shall examine all drawings and read all divisions of this specification in order to avoid omissions and duplications and to ensure a complete job. No allowances shall be made for failure to read and understand these documents. Discrepancies between drawings and specifications or obvious omissions shall be referred to the Systems Designer for clarification before the bid date. Where discrepancies occur and pre-bid instructions have not been obtained, the contractor agrees to abide by the Systems Designer's decision.
2. Bid proposals shall include all work and all equipment as specified, as well as any other equipment and materials to be used in assembling the system.
3. No portion of the work herein may be assigned or sub-contracted to others unless the following requirements have been satisfied:
 - a. The names of any proposed sub-contractors shall have been disclosed in the bid proposal.
 - b. A statement of qualifications for each sub-contractor shall have been included with the bid proposal.
 - c. All terms of this contract, including bidding and qualification requirements, shall apply to the sub-contractor.
4. The bid submittals shall include the following:
 - a. The total Contract price.
 - b. An itemized list of all equipment and materials to be used in assembling these systems.
5. Unit pricing for all items on the specified equipment list.
6. Lot pricing for miscellaneous items not on the specified equipment list.
7. A breakdown of the number of staff hours allotted for:
 - a. Preparation of submittals, shop drawings, and system documentation.
 - b. On site coordination meetings and supervision.
 - c. In shop engineering, fabrication, and assembly.
 - d. On site fabrication, assembly, and installation.
 - e. On site verification and acceptance testing

C. Shop Drawing Submittals:

1. Within sixty (60) days after contract award, submit two (2) copies of detailed shop drawings to the Architect for approval. All shop drawings shall be marked with the related drawing number when submitted. Do not begin installation or fabrication without the approval of the Architect and Systems Designer.
2. Review of shop drawings shall not constitute final approval of system function. Said review does not in any way relieve the Contractor from the responsibility of furnishing material or performing work as required by the Contract documents.
3. Failure of the Contractor to submit shop drawings in ample time for evaluation shall not entitle the Contractor to an extension of contract time, and no claim for extension by reason of such default will be allowed.
4. At a minimum, the Shop Drawings shall include neatly bound copies of the following:

- a. Table of Contents.
 - b. A block diagram indicating proposed interconnections of all equipment and indicating equipment types and model numbers.
 - c. Drawings of loudspeaker mounting arrangements, equipment rack layouts, and receptacle and control plates and boxes.
 - d. Plate and panel Schedule listing all plates and individually with size, mounting condition, back box size and finish color.
 - e. Drawings of projector mounting arrangements and sight line studies showing proper alignment and dimensions with the projection screen and projection equipment.
 - f. Drawings of custom plate and panel details, patch bay layouts and all other necessary wiring diagrams.
 - g. Drawings showing cable pull assemblies and schedule complete with all wiring requirements for the project.
 - h. Drawings of all final assemblies of loudspeaker, screen, and projector suspension equipment stamped by a certified structural engineer.
 - i. Drawings of anchoring system for loudspeaker suspension.
 - j. Submit samples of all panels, custom loudspeaker grills, and loudspeaker cabinet finishes.
 - k. A block diagram of proposed power sequencing sequence.
 - l. Coordinate frequency usage with Owner's designated representative prior to submitted show drawings.
 - 1) Submit list of frequencies used in system together with known existing frequency usage in area, including all local television stations.
5. The above listed Drawings shall be produced on AutoCAD or similar computer graphics program. Scans or photocopies of the Systems Designer's specification drawings are not acceptable.
 6. The use of electronic files from other sources (e.g., architectural backgrounds, Systems Designer's drawings, vendor-supplied panel drawings) will not absolve the Contractor of responsibility for ensuring that the Shop Drawings represent a completely engineered, coordinated solution. The Contractor has final responsibility for providing systems which conform to all requirements of this specification.

D. Finishes

1. Obtain Consultant and Architect approval of all panel and furniture finishes prior to fabrication. The Architect will specify exact finishes.
- E. Field Supervisor
1. Before beginning installation, submit the name of the employee who will be the on-site field supervisor through the completion of this project.
- F. Copies
1. Submit a minimum of (5) copies of all required submittals.
- G. Qualifications:
1. Bidder shall be a system contractor, normally engaged in the full time business of audio-visual and sound reinforcement system installation. Provide evidence that the bidder has been in business for at least five years prior to bid date and has completed projects of similar size and scope.
 2. References, including names and telephone numbers of individuals who may be contacted, showing satisfactory completion of three or more projects similar in scope and type to that specified herein.
 3. Provide additional evidence of satisfactory completion of audio-visual system installations involving suspended loudspeakers, screens, and complex control system integration.
 4. Evidence of ability and affirmation of intent to meet the guarantee and service requirements stated herein.
 5. Qualifications of certified control system programmer who will be working on this project.
 6. Each vendor shall include a description of the professional and technical experiences background, qualifications and expertise of the organization's key personnel assigned to this project. The description shall show that bidder possesses the demonstrated skills and experience in specific areas of the project scope in addition, Bidder shall identify a project manager for the project and shall provide resumes of all personnel who shall be assigned to this project. Bidder shall estimate the percentage of time each individual shall be working on this project.

1.08 MATERIALS AND EQUIPMENT

- A. All systems proposed herein shall meet the best commercial practices of the applicable industries, except where alternatives are noted. Publications of issues of the following standards form a part of this specification:
1. American Institute of Architects (AIA)
 2. Americans with Disabilities Act (ADA)
 3. American National Standards Institute (ANSI)
 4. Audio Engineering Society (AES)
 5. Computer Security Institute (CSI)
 6. Federal Communications Commission (FCC)
 7. Institute of Cable Engineers (ICEA)
 8. Institute of Electrical and Electronic Engineers (IEEE)
 9. International Standards Organization (ISO)
 10. International Telecommunications Union (ITU)

11. National Association of Broadcasters (NAB)
12. National Electric Code (NEC)
13. National Electronic Manufacturers Association (NEMA)
14. National Fire Protection Association (NFPA)
15. National Institute for Certification in Engineering Technology (NICET)
16. Occupational Safety and Health Administration (OSHA)
17. Society of Motion Picture and Television Engineers (SMPTE)
18. Telecommunications Industry Association (TIA)
19. Underwriters Laboratories (UL)
20. Nationally recognized standards of the various construction trades, as may be applicable.

B. Substitutions:

1. Subsequent to Contract award, substitutions may be permitted, but only with the express written permission of the Systems Designer. The proposed substitutes must be equivalent to the specified products in quality, performance, construction, function and conformance to system objectives.
2. It is the responsibility of the Contractor to prove, to the satisfaction of the Systems Designer, that the proposed substitution is equal to the specified product, as demonstrated by submission of the following:
 - a. List of advantages to the Owner.
 - b. Cost savings.
 - c. Printed specifications or laboratory test data.
 - d. Previous field experience.
3. The Contractor shall list the unit price of each item proposed for substitution and indicate which specified items are to be deleted.
4. If the Systems Designer determines that the proposed product is not equal to the specified project, the Contractor shall supply the product specified in the Contract documents.
5. Where substitute materials or methods are approved, the Contractor shall make all adjustments to contingent work necessary to accommodate the substituted equipment, without claim for additional payment.
6. In the event that one (1) or more of the products specified herein is unavailable, the Contractor shall make recommendations to the Systems Designer as to what substitutions are available to meet the intent of the specification.
7. The Systems Designer reserves the right to substitute new products which become available subsequent to the issuance of the Contract Documents, provided
 - a. The Contractor has not yet purchased the originally specified equipment.
 - b. The substitute equipment shall not materially increase the Contractor's costs.

C. Samples:

1. Submit samples of substitute equipment to the Systems Designer as required to prove equivalency to items specified.
2. Submit samples of custom work, finishes or other materials as required by the Architect or Systems Designer to verify appearance and quality.
3. Costs for shipping samples shall be the responsibility of the Contractor.

D. Written Guarantee as described in this section.

E. Verification Test Report as described in this section.

F. System Documentation and Operation Manuals as described in this section.

1.09 JOB CONDITIONS

A. Keep the job adequately staffed at all times. Unless illness, loss of personnel or other circumstances beyond the control of the Contractor intervene, keep the same individual in charge throughout.

B. Cooperate with all appropriate parties in order to achieve well-coordinated progress with the overall construction completion schedule and satisfactory final results.

C. Watch for conflicts with work of other contractors on the job and execute, without claim for extra payment, moderate moves or changes as are necessary to accommodate other equipment or to preserve acoustic performance, symmetry, and pleasing appearance.

D. Immediately report to the Architect and Systems Designer, any design or installation irregularities, particularly architectural elements that interfere with the intended coverage angles of loudspeakers, so that appropriate action may be taken.

E. Do all cutting, patching and painting for proper and finished installation of the system and repair any damage done as a result of such installation. Clean up and dispose of trash from all Systems work areas.

1.10 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain all materials from one (1) source from a single approved manufacturer for each different product required.

B. Integrator and installation contractor MUST be:

1. A certified installation contractor for all manufacturers used in this installation.
2. A Crestron A+ Certified Installer.

C. Parts listed shall be complete, type numbers accurate and equipment furnished shall conform to manufacturer's specifications.

D. All materials shall be new and shall conform to applicable provisions of Underwriters Laboratories and the American Standards Association.

- E. Procure and pay for all permits, licenses and inspections and observe any requirements stipulated therein. Conform in all trades with all local regulations and codes.
- F. Comply with federal; state and local labor regulations and applicable union regulations.
- G. Installation shall conform to latest federal, state and local electrical and safety codes or those of other authorities having jurisdiction. Where conflicts exist, most stringent code or regulation shall apply.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Take care in handling products in accordance with manufacturer's instructions.
- B. Store indoors in original undamaged packaging, in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Store products upright in secure, protected area. Do not stack! Verify with manufacturer that site conditions are acceptable before receiving material.
- C. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
 - 1. Interior, Controlled Environment: System components installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and twenty to ninety percent (20-90%) relative humidity.

1.12 FUNCTIONAL REQUIREMENTS

- A. The system shall provide the following functions:
 - 1. Gymnasium/Cafeteria Sound Amplification System:
 - a. Reinforcement of speech from wired microphone receptacles and wireless microphone systems to listener in the designated room through ceiling or wall mounted speakers as dictated on the plans and within this specification.
 - b. Operator controlled mixing of microphone signals using a rack mounted mixing console.
 - c. Assistive listening system using portable wireless FM receivers.
 - d. Reproduction of audio material using a compact disc player unit located in equipment rack for use with mixing console.
 - e. Muting of all audio signals in response to fire alarm control signal from fire alarm signal.
 - f. Integration of audio from Public Address System to sound reinforcement speakers.
 - g. Sound reproduction from multi-media inputs.
 - 2. Auditorium Room Audio Video System:
 - a. A/V reproduction from designated input to projector and electric screen.
 - b. Extend Audio feed from projector to existing speaker system.

1.13 ACOUSTICAL PERFORMANCE CRITERIA

- A. The overall space-average acoustical frequency response criterion, as measured within the coverage area of the system loudspeakers, is within ± 3 dB of a spectrum which is flat from 125 to 2500 Hz and slopes downward thereafter at a rate of 3 dB per octave to 12,500 Hz. Test signals shall be broad-band "pink" noise applied to any system input, measured using 1/3-octave filters centered on ANSI preferred frequencies.
- B. Measurements of system performance will be made using calibrated ANSI or IEC precision sound level meter set for "slow" meter damping and flat response, 4 feet above the floor (seated ear height) within the system coverage area. All interior finishes and furnishing shall be in place, and system gain shall be adjusted to provide levels of at least 70 dB, or 10 dB above background noise levels, whichever is higher, at the measuring locations for these tests.
- C. The spatial level uniformity criterion, throughout the sound system coverage areas, is that amplified sound levels shall not vary more than ± 2 dB as measured using a test signal consisting of an octave band of "pink" noise centered at 2,000 Hz.
- D. To meet acoustical performance criteria, be responsible for:
 - 1. Use of equipment specified in the manner specified.
 - 2. Each component's conformance with its manufacturer's published specifications and other requirements as stated herein.
 - 3. Detailed checking of each item of equipment provided, each portion of the installation, and of the complete installation to find and remedy any defects therein.
 - 4. Setting and documenting the adjustments of loudspeakers, equalizers, and other signal-processing equipment, pads, and gain controls, and if so directed by the Architect making the further adjustment of these items, providing additional field-assembled resistive pads and/or resistor-capacitor equalizers.
 - 5. Adjust all equalizers to realize maximum gain and optimal tonal balance from the sound system throughout the audience area.
- E. Output level of all program sources arriving at switching and routing equipment shall be within ± 0.25 dB of each other as measured at the input to the switcher or router. Provide pads, line amplifiers or other gain control devices as required to achieve this specification.
- F. System frequency shall be 20 – 20 KHz ± 3 dB, unless the known, published specifications of a particular piece of mixing, processing, amplification or transducing equipment limit this specification.
- G. System signal to noise ratio shall be 60 dB or greater, unless the known, published specifications of a particular piece of mixing, processing, amplification or transducing equipment limit this specification.

1.14 VIDEO PERFORMANCE CRITERIA

- A. Provide systems that meet the performance requirements stated in this section. Perform any work required to modify the performance of the system in order to meet these requirements. Perform whatever tests are necessary to confirm compliance with these requirements, before commencement of acceptance testing.
- B. Analog Signal Distribution and Cabling:
1. The Video distribution and cabling system shall meet or exceed the following electrical specifications, measured at any point in the system. Compliance with these specifications shall be determined by introducing a standard video reference signal at points normally used for origination (e.g., DVD player, workstation) and measuring the signal characteristics at points normally serving as destinations (e.g., monitor, projector, DVD player). Note that these are end-to-end performance requirements to be met under all conditions of switcher re-entrance.
 2. For purposes of this paragraph, the distribution and cabling system shall include all equipment and cabling normally within the signal path.
 3. Frequency response shall be ± 1.5 dB, DC to 100MHz for computer and component video signals and ± 0.5 dB; DC to 5.0 MHz for NTSC encoded composite video signals.
 4. Rise time shall be 250 V/microseconds minimum.
 5. Crosstalk shall be 45-dB minimum below nominal signal level, unweighted DC to 70 MHz.
 6. Signal to Noise Ratio shall be 45-dB minimum, peak noise to RMS signal, unweighted DC to 70 MHz.
 7. Signal Gain shall be unity (1.00) terminated into 75 ohms.
 8. Line and Field Tilt shall be less than 2 percent.
 9. Differential Gain shall be less than 3 percent.
 10. Differential Phase shall be less than 3 degrees.
 11. Color Timing (where applicable) shall be within 2 degrees at 3.58 MHz.
 12. Input Return Loss shall be 40-dB minimum, DC to 70 MHz.
 13. Path Length Inequality for Y/C and RGBS cable sets where the signals are not subject to subsequent matrixing or encoding shall be within 12 inches of cable length, or 1.6 nsec.
 14. If cable length results in the deterioration of gain and frequency response characteristics and cable compensation equipment are not specified, the system shall be adjusted for best performance. The Contractor shall be able to demonstrate that any inability to meet gain and frequency response specification is due solely to length of cable.
- C. Digital Signal Distribution Cabling
1. Provide digital signal distribution system with the following features:
 - a. EDID management
 - b. Latest HDCP protocol compliance
 - c. HDMI, DVI, & DisplayPort signal transport
 - d. Troubleshooting tools
 - e. Support for video formats up and including 1920 x 1200.

D. Displays (Monitors and Projectors)

1. All displays shall meet manufacturers published specifications for brightness, contrast, focus, convergence, linearity, distortion, and purity, across the entire range of horizontal and vertical scan frequencies of which the display is capable. In the absence of such specifications, no convergence, linearity, distortion, or purity errors shall be visible from a viewing distance equal to the image width, and brightness contrast and focus shall be standard performance guidelines.
2. Projectors shall be installed and adjusted so that the resultant images are free from keystone and barrel distortion.
3. Projectors shall exhibit correct color balance, both at black and at peak white, and proper gray scale tracking.
4. All displays shall meet manufacturers published specifications for horizontal and vertical scan frequency ranges. Where appropriate, adjustments shall be made to allow for automatic scan locking across specified ranges. Image quality specifications discussed above shall be met throughout the horizontal and vertical scan frequency ranges.

1.15 DIAGRAMS, INSTRUCTION MANUALS

- A. Provide draft copies of all required diagrams and instruction manuals on-site for inspection during the demonstration and acceptance testing of the system; submit final copies thereafter.
- B. Simplified Line Diagram:
 1. Show the essential parts of the completed installation and their functional relations including all jacks, numbered according to their position on the system patch panels (A, B, etc. for horizontal rows, 1-26 for vertical columns). Mount one copy of the diagram behind clear plastic on the wall near the equipment rack, or as directed. Bind one copy of the diagram into each instruction manual. Reduce the mounted copy to 11" x 17" maximum; insure that it is legible at that size.
- C. Receptacle Plans:
 1. Provide 11" x 17" plans showing the location and designation of all receptacles and loudspeakers. Provide separate plans for line/microphone receptacles, loudspeakers receptacles and other receptacles. Indicate jack numbering on plans. Mount one copy and bind other copies into manuals as specified for the line diagram.
- D. Operating Manual:
 1. Create system specific usermanual for the complete system including user instructions for accessing all the system functionality specified in Function Requirements. Manual should describe how to use individual components in their context as part of a larger system. A compilation of manufacturer's manuals for components does NOT meet this requirement.
- E. Complete Instruction Manuals:
 1. Provide complete instruction manuals which include the following:
 - a. Table of contents
 - b. List of loose items furnished
 - c. List of functional requirements.

- d. Operating manual (see above)
 - e. List of settings and adjustments for semi-fixed controls.
 - f. Manufacturers sheets of specifications, operating instructions, and service information arranged alphabetically by manufacturer and then by model number, for each item of equipment specified herein.
 - g. Detailed system wiring diagrams, including cable schedules, DSP functional diagram printouts and copies of all drawings specified above. Also include all submitted shop drawings to indicate as built conditions.
 - h. Provide to Owner and retain a copy of all operating software, if any, and manuals, including custom software.
 - i. Provide source code for all custom programming created for this project on USB memory stick.
 - j. Provide print-out of all touch panel pages.
 - k. Provide five bound copies.
- F. Record Drawings:
- 1. Provide record drawings of as-built conditions in ACAD and PDF file format based on contractor's updated base drawings. Drawings shall include at a minimum:
 - a. Device location plan
 - b. Functional diagram with wire numbering
 - c. Panel and rack details
 - d. Wiring details
 - e. Loudspeaker suspension details
 - 2. Provide CD with ACAD files and one black line print of drawings.

1.16 INSTRUCTION

- A. Provide instruction of Owner's designated operating personnel. Include a minimum of three four-hour sessions for a total of twelve hours of instruction in the operation, care and maintenance of the installation. Schedule multiple sessions over a one or two year period across both Fall and Spring School Sessions.
- B. Schedule instruction at the mutual convenience of the Owner and Contractor, after demonstration and acceptance testing. Provide a DVD recording or otherwise coordinate with the Owner the recording of all instruction sessions and provide a copy of each major session to the Owner.
- C. Six months after completion of the installation, the Contractor shall provide a control system review making any minor changes to the touch panel and control system as the Owner may request based on the configuration sign-off.

1.17 GUARANTEE AND SERVICE

- A. All systems and components shall be guaranteed free of defects in materials and workmanship for a period of one (1) year from the date of acceptance and shall be repaired or replaced within forty-eight (48) hours following report of such defects by the Owner.

- B. The Contractor shall be available on call and on eight (8) hour notice during the first month following acceptance of the system, to assist the Owner's representatives in any problems that may arise during the initial period of operation.
- C. If, during the Guarantee period, any component is out of service for more than seven (7) consecutive days due to unavailability of parts or service, Contractor shall supply and install an identical new component. If an identical component is not available, Contractor will substitute equivalent equipment, with the approval of the Owner.
- D. During the course of the Guarantee period, the Contractor shall provide a minimum of three (3) service visits to the site for inspection and adjustment of equipment. Contractor shall submit proposed schedule for these visits and shall notify Owner and Systems Designer in writing at least one month in advance of each visit.
- E. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of any device and equipment related to operation, and equipment that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Unless stated otherwise within product descriptions, a two (2) year warranty from date of Substantial Completion shall be provided.
 - 2. Provide information on available extended warranties.

1.18 INSURANCE

- A. All equipment and materials shall be fully insured against loss or damage up until acceptance of this system by the Owner or until the Owner relieves the Contractor in writing of this responsibility, whichever is earlier.

PART 2 - PRODUCTS

2.01 WIRING AND CONNECTIONS

All cable shall be plenum rated.

- A. Audio Input Lines:
 - 1. Use cable with a foil shielded pair of stranded #22 AWG conductors, with a stranded shield drawn wire. For single pair, use a miniature cable nominal outside diameter 0.135". Use of a multi-pair cable is optional. Provide plenum rated equivalent as required.
 - a. Belden
 - b. Mohawk
 - c. West Penn
- B. Loudspeaker Wiring:
 - 1. Provide unshielded loudspeaker wiring for connection to loudspeakers and loudspeaker receptacles. For lines in rigid conduit or electrical tubing, use stranded or solid conductors. For lines in flexible conduit or electrical tubing and for all wiring to equipment within equipment racks, use only stranded conductors.

2. Use color-coded #12 AWG conductors for all loudspeakers and electronically-delayed loudspeakers except for 70 V ceiling-mounted loudspeakers and loudspeaker receptacles.
 - a. Belden
 - b. West Penn
 - c. Approved Equal
 3. For all ceiling-mounted loudspeaker wiring using 70 Volt lines provide color-coded #18 AWG loudspeaker wiring.
 - a. Belden
 - b. West Penn
 - c. Approved Equal
 4. Use color-coded #14 AWG conductors for all loudspeaker receptacle wiring
 - a. Belden
 - b. West Penn
- C. Antenna Wiring:
1. Provide coaxial antenna wiring for connections from wireless transmitters and receivers to antenna connection panels.
 - a. Belden
 - b. Approved equal
- D. Category Wiring:
1. Provide Category 6 8-conductor unshielded twisted pair cable with 23 AWG solid conductors and bandwidth of 250 Mhz for computer data and audio visual transport wiring.
 - a. Berk-Tek
 - b. Superior Essex
 - c. Belden
 2. Provide shielded twisted pair cable for use in Crestron DM systems.
 - a. Crestron DM-CBL-8G-P
- E. Category Patch Panel:
1. Provide 12-port rack-mount category 6 patch panel. Provide one 2-foot patch cable per wired port on patch bay.
 - a. Leviton eXtreme
 - b. Hubbell NextSpeed
 - c. Approved Equal
 - 1) Quantity: per Drawings
- F. Connectors:
1. Connectors from the following manufacturers shall be considered acceptable. Install connectors appropriate for the installed cable and equipment interface.
 - a. ADC
 - b. Amp
 - c. Amphenol
 - d. Canare
 - e. H.H. Smith
 - f. Kings
 - g. Neutrik

- h. Ponoma
 - i. Switchcraft
 - j. Trompeter
 - k. Approved Equal
- G. Input Connection Plates
- 1. All plates are black anodized aluminum with engraved or laser etched white lettering unless otherwise noted.
 - a. Wall-mounted plates: custom color/finish by architect or stainless/brushed aluminum
 - b. Wall-mounted plates in stage areas (behind proscenium): black
 - c. Wall-mounted plates at catwalk and overhead areas: black
 - d. Floor-box mounted plates: black
- H. Microphone Extension Cable:
- 1. Provide 25-foot long rubber-covered flexible microphone extension cables. Fit each flexible extension cable with black three conductor XLR microphone receptacles. Provide one microphone cable per microphone.
 - a. Wireworks C25
 - b. Pro Co M25
 - c. Approved Equal Assembly
 - 1) Quantity: As required by number of microphones provided.
- I. Transformer:
- 1. Jensen Transformer JT-11SSP-6M
 - 2. ProCo LOT-1
 - a. Quantity: per Drawings
- J. Line Input Transformer:
- 1. Jensen Transformer JT-11p-1
 - a. Quantity: per Drawings
- K. Dual Line Output Transformer:
- 1. Jensen Transformer DIN-2LO-11FI
 - a. Quantity: per Drawings
- L. Dual Two-Way Microphone Splitter:
- 1. Jensen Transformer DIN-MS-2P
 - a. Quantity: per Drawings
- M. Terminal Blocks:
- 1. Provide DIN-rail mounted terminal blocks where indicated on functional diagrams for microphones and line level lines.
 - a. Acceptable manufacturers
 - 1) Wago
 - 2) Entrelec
 - 3) Approved Equal
 - 2. Provide DIN-rail terminal blocks, barrier strips, or euro-style blocks for loudspeaker level lines.

N. Surface Mount Electrical Gang Boxes:

1. Provide surface mount electrical gang boxes for all surface and pipe mount audiovisual devices in project. Coordinate mounting condition and requirements with telectrical contractor. Provide in black or white as required to match faceplate finish.
 - a. FST SMWB Series
 - b. Leviton BKBX Series
 - c. Electronic Theatre Controls Equal

2. AUDITORIUM DIGITAL AUDIOVISUAL TRANSPORT SYSTEM

a. Manufacturer:

- 1) Basis of Design: CRESTRON DIGITAL MEDIA
- 2) Acceptable alternates:
 - a) EXTRON XTP Series

b. Input Panel & Receiver:

- a) Crestron HD-MD-300-C-E
 - 1) Quantity: per Drawings

3. AUDITORIUM PROJECTOR

a. Manufacturer:

- 1) Basis of Design: NEC
- 2) Acceptable alternates:
 - a) SONY
 - b) PANASONIC

b. Projector and Lens:

- 1) Provide 8500 lumen projector capable of large scale projection with HDMI inputs. Shall be powered over 120 V AC.
 - a) Panasonic NP-PX-1004UL-BK
 - 1) Quantity: 1
 - b) NEC Lens Specify:
 - 1) Quantity: 1

2.02 SOUND REINFORCEMENT SYSTEMS FOR CAFETERIA & GYMNASIUM.

A. Provide the following sound reinforcement Audio Input System in the:

1. Gymnasium
2. Cafeteria

B. Contractor shall provide a local sound system per each area indicated above, which shall include:

1. QTY (1) rack type amplifier.
2. QTY (1) feedback eliminator.

3. QTY (1) system for the hearing impaired as specified elsewhere within this written specification.
 4. QTY (1) wireless microphone distribution system.
 5. QTY (1) wall mounted cabinet and associated equipment.
 6. QTY (1) rack mount mixer
 7. Capability to mute system upon receiving signal from public address system.
 8. Capability to shut down system upon receiving signal from fire alarm system.
- C. The system(s) shall provide audio mixing and amplification for:
1. Minimum of four (2) low impedance dynamic microphones, but not less than the number of microphone outlets shown on the drawings.
 2. One (2) wireless microphones.
 3. One (1) CD/MP3 Player/Recorder.
 4. One (1) Audio input from a remote iPod or DVD.
- D. Rackmount mixer for Cafeteria, Gymnasium, & Multi Purpose Room:
1. Manufacturer:
 - a. Basis of Design: BEHRINGER
 - b. Acceptable alternates:
 - a) SHURE
 - b) RAINE
 2. The rack type mixer shall be **BEHRINGER MX882** or approved equal.
 - a. The mixer shall provide controls for up to eight (8) inputs using rotary potentiometers.
 - b. The equalizer shall be a nine-band constant Q slide potentiometers, 63-16 KHz, with center-off detent for rapid "flat" setting. Each filter section shall allow up to 12 dB of cut or boost. Provide a cover plate to prevent tampering with equalizer setting.
 - c. The following quantities shall be provided:
 - 1) Cafeteria QTY (1)
 - 2) Gymnasium QTY (1)
 - 3) Multi Purpose Room QTY (1)
- E. Rackmount Amplifiers for Cafeteria, Gymnasium, & Multi Purpose Room
1. Basis of Design: Lab.Gruppen
 2. Acceptable alternates:
 - a. QSC
 - b. Crown
 3. The rack type amplifier shall be **Lab.Gruppen IPD Series** or approved equal.
 - a. The amplifier shall be of the low-distortion, fully complementary symmetry type, providing 150 watts of output. The frequency response shall be a minimum of 20 to 20,000 Hz. +0/-1.2 dB (at 9 dB below rated output per EIA Standard SE-101A), with a direct-coupled distortion of less than 0.4% from 20-20 KHz at rated output. The amplifier output shall be user selectable as either direct-coupled or transformer-isolated (25V or 70V). The frequency response of the transformer-isolated outputs shall be +0/-1.6 dB, 20 to 20,000 Hz at 9 dB below rated output.
 - b. The amplifier shall have an integrated DSP.

- c. The following quantities shall be provided:
 - 1) Cafeteria QTY (A/R)
 - 2) Gymnasium QTY (A/R)
 - 3) Multi Purpose Room QTY (A/R)

- F. Sound Reinforcement Equipment Rack for Cafeteria, Gymnasium, & Multi Purpose Room
 - 1. The Equipment Rack shall be **MIDDLE ATLANTIC CWR-18-32PD** or approved equal.
 - 2. The equipment rack shall have a locking front door.
 - a. The following quantities shall be provided:
 - 1) Cafeteria QTY (1)
 - 2) Gymnasium QTY (1)
 - 3) Multi Purpose Room QTY (1)

- G. Feedback Eliminator
 - 1. Provide a feedback eliminator to eliminate feedback without muting or muffling. The unit shall be fully connected to the local sound system. Feedback exterminator shall be Sabine **#FBX-1020Plus** or approved equal.
 - a. The following quantities shall be provided:
 - 1) Cafeteria QTY (1)
 - 2) Gymnasium QTY (1)
 - 3) Multi Purpose Room QTY (1)

- H. Hard-Wired Microphones & Accessories:
 - 1. Basis of design: SHURE SM
 - 2. Acceptable alternates:
 - a. AudioTechnica
 - b. Sennheiser
 - 3. Microphones shall be SHURE **#SM58S** or approved equal.
 - a. The following quantities shall be provided:
 - 1) Cafeteria QTY (2)
 - 2) Gymnasium QTY (2)
 - 3) Multi Purpose Room QTY (2)
 - 4. Microphone Stands shall be WIRLWIND **#STNDMR** or approved equal.
 - a. The following quantities shall be provided:
 - 1) Cafeteria QTY (2)
 - 2) Gymnasium QTY (2)
 - 3) Multi Purpose Room QTY (2)
 - 5. Microphone cables shall be Pro Co M25 or approved equal.
 - a. The following quantities shall be provided:
 - 1) Cafeteria QTY (2)
 - 2) Gymnasium QTY (2)
 - 3) Multi Purpose Room QTY (2)

- I. Wireless Microphones & Antenna Systems:
 - 1. Basis of design: SHURE SLX
 - 2. Acceptable alternates:

- a. AudioTechnica
 - b. Sennheiser
 3. Handheld Wireless Microphones shall be SHURE SLX24 / SM58 or approved equal
 - a. The following quantities shall be provided:
 - 1) Cafeteria QTY (2)
 - 2) Gymnasium QTY (2)
 - 3) Multi Purpose Room QTY (2)
 - b. UHF transmitters & powered antenna splitters shall be sized to accommodate above quantities. Refer to drawings for more information.

 - J. Gymnasium Speakers shall be **ELECTRO-VOICE SX100+**
 1. QTY (per plans)

 - K. Cafeteria Speakers basis of design: EVID
 1. Acceptable alternates:
 - a. Fulcrum Acoustic
 - b. QSC

 - L. Cafeteria speakers shall be **EVID #6.2**
 1. QTY (per plans)

 - M. Loudspeaker, Projector, and Screen Rigging Suspension Equipment:
 1. Provide loudspeaker rigging for loudspeaker clusters and suspended loudspeakers. Suspend loudspeaker components from brackets and any necessary suspension frames to minimize total number of ceiling hanging points. Provide with a sufficient number of suspension points for field adjustment of loudspeaker aiming. Provide with color as designated by the Architect. During fabrication and installation verify that adequate clearance from all other hanging components and adequate clearance from structural steel is provided. Provide any additional rigging hardware necessary for the safe and proper installation of these loudspeakers.
 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Ape Rigging
 - b. Polar Focus
 - c. Approved Contractor Fabricated Assembly (*SHOW EVIDENCE OF SUCCESSFUL COMPLETION OF PREVIOUS PROJECTS)
 3. Submit all drawings of the complete final rigging assemblies to a certified structural engineer and obtain approval and stamped copies of the drawings. Drawings should detail all connections from attachment to building structure to loudspeaker.
 4. Refer to Architectural plans for Projector and Screen Mounting Requirements.
- 2.03 ASSISTED LISTENING EQUIPMENT
- a. Contractor shall provide a system for the hearing impaired for each sound system as specified in the bid documents and this written specification.

- b. Provide wireless assistive listening system consisting of an FM transmitter, an antenna mounted as indicated on drawings, and portable battery-operated receivers with earphones and inductive couplers. Provide frequencies separate and free from interference with other FM systems. Provide all assistive listening system components from the same manufacturer.
 - c. The system shall be frequency modulated and fully connected to the local sound system and the public address systems central console.
- A. The antennae shall NOT be mounted directly on the transmitter. It shall be mounted outside the housing cabinet at the location as directed within the architectural drawings.
- 1. Antenna shall be extended with antenna cable to the transmitter.
 - 2. All cabling from the antenna to the transmitter shall be procured and installed for a complete and functional system.
- B. Provide an additional eight (8) single channel receivers for the local sound system.
- C. Minimal specification on all equipment is based on the parts specified below, all substituted devices must meet or exceed this equipment.
- D. Assisted Listening basis of design: Listen Technologies
- 1. Acceptable alternates:
 - a. Williams Sound
- E. Equipment and quantities shall be provided in each area as described below:
- F. CAFETERIA
- 1. Total seating: 284
 - 2. Transmitter
 - a. Listen Technologies LT800-072 with LA-326 rack mounting kit. 72 MHz, Wide band frequency
 - 1) Quantity: 1
 - 3. Transmitter Antenna
 - a. Listen Technologies LA-122
 - 1) Quantity: 2
 - 4. Receiver
 - a. Listen Technologies LR-400-216
 - 1) Quantity: 12
 - 5. Replacement Cushion
 - a. Listen Technologies LA-163
 - 1) Quantity: 100
 - 6. Over-Ear Earphones
 - a. Listen Technologies LA-164
 - 1) Quantity: 12

7. Neckloop Induction Coil
 - a. Listen Technologies LA-166
 - 1) Quantity: 3
8. Portable Charging Case
 - a. Provide portable charging cases with total capacity equal to or greater than quantity of receivers specified above.
 - 1) Listen Technologies LA-311

G. GYMNASIUM

1. Total seating: 959
2. Transmitter
 - a. Listen Technologies LT800-072 with LA-326 rack mounting kit. 72 MHz, Wide band frequency
 - 1) Quantity: 1
3. Transmitter Antenna
 - a. Listen Technologies LA-122
 - 1) Quantity: 2
4. Receiver
 - a. Listen Technologies LR-400-216
 - 1) Quantity: 34
5. Replacement Cushion
 - a. Listen Technologies LA-163
 - 1) Quantity: 100
6. Over-Ear Earphones
 - a. Listen Technologies LA-164
 - 1) Quantity: 34
7. Neckloop Induction Coil
 - a. Listen Technologies LA-166
 - 1) Quantity: 9
8. Portable Charging Case
 - a. Provide portable charging cases with total capacity equal to or greater than quantity of receivers specified above.
 - 1) Listen Technologies LA-311

2.04 GENERAL EQUIPMENT

- A. Whenever manufacturer and model number specify any equipment, it is for purposes of establishing a standard of quality, performance, construction and function.
- B. Equipment models provided shall operate at the required AC line voltage and frequency.
- C. Contractor shall provide quantities as indicated in the equipment list, detail drawings, location drawings, schedule of terminations, and as required for a complete installation.

D. Audio & Video Wire and Cable

1. All wire numbers listed in the Drawings are Belden unless otherwise noted.
2. All THHN conductors shall be stranded.
3. Approved Manufacturers: Alpha, Belden, Canare, Mogami, West Penn, Whirlwind.

PART 3 - EXECUTION

3.01 Installation

- A. This specification shall include all installation and setup labor and configuration of all devices to furnish a complete, efficient and effective system.
- B. The Contractor awarded this project shall perform all network IP addressing and configuration required for all devices described within this specification.
- C. All cables, connectors and peripheral equipments required to attain a fully functional system shall be furnished, installed and performed by the contractor awarded this project.
- D. Locate all apparatus requiring adjustments, cleaning or similar attention so that it will be accessible for such attention. Equipment racks shall be positioned to permit full access for operation and service.
- E. Furnish and install brackets, braces and supports. Minimum fastening or support safety factor shall be at least three (3). Design shall be to the approval of the Architect.
- F. All supporting structures and enclosures supplied by the Contractor not having a standard factory paint finish shall be painted. Paint specifications will be supplied by the Architect or indicated herein.
- G. Provide custom color or finish for any equipment or materials supplied which are exposed to public view. Color and finish of all such equipment or materials shall be approved in writing by the Architect. This does not exclude equipment or materials where standard colors and finishes may be specified herein.
- H. Finish of blank panels and custom assembly panels shall match adjacent equipment panels.
- I. Switches, connectors, jacks, receptacles, outlets, cables and cable terminations shall be logically and permanently marked. Custom panel nomenclature shall be engraved, etched or screened. Markings for these items are detailed in the drawings to ensure consistency and clarity. Verify any changes in working type size and/or placement with the Systems Designer prior to marking.
- J. The equipment specified herein is designed to operate in environments of normal humidity, dust and temperature. Protect equipment and related wiring where extreme environmental conditions can occur.

- K. Secure equipment firmly in place, including control panels, loudspeakers, conduit, amplifiers, racks, and cables. Make fasteners and supports to support their loads with a safety factor of at least three.
- L. Take precautions to prevent electromagnetic and electrostatic hum. Install equipment to provide safe operation.
- M. Clearly, consistently, logically, and permanently mark switches, connectors, jacks, relays, receptacles, cables, and cable terminations. Engrave and paint-fill all panel and receptacle markings, directly on the material on which controls or receptacles are mounted. Fill engraving with black or white paint, whichever contrasts best with panel finish or as directed by the architect. Use no hand-lettering, embossed tape (e.g. Dymo labels), or any adhesive- or otherwise mechanically attached labels for any labels visible to operators or public during normal system operation. Use screw attached engraved or laminated labels on manufactured assemblies, such as amplifiers, which otherwise would require disassembly for direct engraving. Use printed adhesive cable markers to mark cables, or other labels intended for the purpose. Insert patch panel labels into clear plastic covered label holders.
- N. Label each receptacle with this type and unique number; for example, "MIC 05", "AV INPUT PANEL", etc. Label each jack with the name of the device to which is connected plus "IN" or "OUT" for output.
- O. Coordinate all Ethernet IP address usage with Owner.

3.02 CONDUIT

- A. Review and coordinate Systems conduit installation with the electrical contractor to ensure proper operation of the Systems.
- B. All wiring shall be in conduit unless authorized by the Architect, approved by the Systems Designer, and permitted by code. Exceptions are short runs at equipment terminations where there is no means of connecting conduit to the equipment.
- C. Where installed exposed, conduits shall be parallel with or at right angles to walls or ceilings and shall be supported from walls or ceilings by means of approved galvanized iron clamps or hangers. Conduit connections to equipment racks shall be insulated.
- D. Minimum size conduit shall be $\frac{3}{4}$ inch. All conduit shall be sized for maximum forty percent (40%) fill or less if required by code.
- E. Use separate steel conduits for microphone-level circuits (below -20 dBm), line-level circuits (up to +30 dBm), loudspeaker circuits (above +30 dBm), control circuits, and power circuits. Use audio conduit which is spaced well away from power conduit. Insulate all conduit from the equipment rack(s); ground conduit only to power system ground. Do not splice lines in conduit. Connect each receptacle by an individual, insulated line to the system equipment rack.

3.03 STEEL SUPPORTS

- A. Fabricate and install any supports so that the installation does not weaken or overload the building structure. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems. No drilling or cutting of concrete beams, joists, or structural steel, nor welding to structural steel, will be permitted except as authorized, in writing, by the Architect.

3.04 BOXES

- A. With the exception of portable equipment, all boxes, conduits, cabinets, equipment and related wiring shall be held in place and the mounting shall be plumb and square.
- B. All boxes shall be securely mounted to building structure. All boxes shall be installed so that wiring contained in them is accessible. Install blanking devices or threaded plugs in all unused holes.
- C. Wiring groups and circuits shall be isolated as indicated herein. Common pull or junction boxes are not permitted except as authorized, in writing, by the Systems Designer.
- D. Clean all box interiors before installing plates, panels or covers.

3.05 WIRING METHODS AND PRACTICES

- A. Provide installation of all Systems wire and cable, ensuring proper:
 - 1. Pulling Tensions
 - 2. Quantities
 - 3. Types
 - 4. Lengths
 - 5. Routing
 - 6. Wire Group Separation
 - 7. Identification
- B. The interconnection of all equipment requiring shielded cable shall be by Belden **Type 9451**, or equivalent, unless otherwise specified.
- C. Spare wire runs of each group and type shall be pulled to each termination location. The number of spares shall be ten percent (10%) of those in actual use or one (1), whichever is greater.
- D. Splicing of cables is not permitted between terminations of specified equipment.
- E. Do not pull wire or cable through any box fitting or enclosure where change of raceway alignment or direction occurs; do not bend conductors to less than recommended radius. Employ temporary guides, sheaves, and rollers to protect cables from excess tension, abrasion or damaging bending during installation.

- F. Provide wire pulling lubricants and pulling tensions in accordance with the wire and cable manufacturer's recommendations.
- G. All wires shall be permanently identified at each wire end by marking with adhesive or crimp-on markers and a chart kept of each wire's function. This applies to wire within a rack assembly as well as wire running in conduit.
- H. Wire ends should be wrapped with heat shrink tubing. Each shield or drain wire should be covered with heat shrink to avoid unintentional connections.
- I. Use ring or tongue lugs on all barrier strip terminals. Do not exceed two lugs per terminal. Use crimping tools which are designed for the application or solder. Do not cut strands from conductors to fit lugs or terminals. Spare terminal blocks, equivalent to ten percent (10%) of those in actual use, shall be provided.
- J. Form, in an orderly manner, all conductors in enclosures and boxes, wire ways and wiring troughs, providing circuit and conductor identification. Tie using tie wraps of appropriate size and type. Limit spacing between ties to 6 inches and provide circuit and conductor identification at least once in each enclosure.
- K. Provide ample service loops at each termination so that plates, panels, patch bays, and equipment can be dismantled for service and inspection.

3.06 GROUNDING

- A. Audio system wiring shall conform to the following procedures:
 - 1. Audio equipment AC ground pins shall connect to AC isolated ground.
 - 2. Audio equipment chassis shall connect to AC isolated ground or rack frames.
 - 3. Audio rack frames shall connect to AC isolated ground bus in panelboard by means of #2 gauge (minimum) conductor.
 - 4. Audio shields between AC powered pieces of equipment shall be connected to ground at one end only. Capacitively terminate as required.
 - 5. Audio signal paths between AC powered pieces of equipment shall be connected using balanced lines and/or transformer isolation as required. No unbalanced signal paths may be connected to the patch bay.
 - 6. Isolate all Systems wiring from racks, back boxes and conduit.
 - 7. Isolate all Systems racks from conduit and other conductive surfaces. Use insulated bushings for conduit connections and a dielectric plinth between racks and conductive flooring materials.
 - 8. AC isolated ground system shall be isolated from all other facility grounds.
- B. All metallic conduit, boxes and enclosures shall be grounded in accordance with the current National Electrical Code.
- C. Metallic enclosures containing active equipment shall be grounded with due regard for the minimization of electrical noise. This may include the provision of grounding conductors separate from the AC ground.

3.07 EQUIPMENT RACKS

- A. The equipment racks shall be considered as custom assemblies and shall be assembled, wired and tested in the Contractor's shop. Assembly of racks on-site will not be permitted (except for shielded microphone and line wiring which must connect directly to the patch bays).
- B. Placement of equipment in equipment racks, as shown in the drawings, is for maximum operator convenience. Verify any changes in placement of the equipment with the Systems Designer before assembly.
- C. Racks shall be installed plumb and square without twists in the frames or variations in level between adjacent racks.
- D. All wire, cable, terminal blocks, rack mounted equipment, and active slots of card frame systems shall be clearly and logically labeled as to their function, circuit, or system. Labeling on manufactured equipment shall be by engraved plastic laminate or by thermal printer on adhesive tape, with white lettering on black background or dark background that is similar to panel finish.
- E. Provide stiffeners to custom panels to prevent panel deformation during normal plugging or switching operations.
- F. All wires and cables used in assembling custom panels and equipment racks shall be formed into harnesses which are tied and supported in accordance with accepted engineering practice.
- G. Harnessed cables shall be combed straight, tie-wrapped every 6 to 10 inches, and attached to the structure as necessary. Each cable that breaks out from a harness for termination shall be provided with an ample service loop to permit equipment removal from the racks without disconnecting.
- H. Harnessed cables shall be formed in either a vertical or a horizontal relationship to equipment, controls, components or terminations.
- I. Cable shields shall be connected to the isolated ground system with due regard for ground loops. (See Giddings reference book, Chapter 10)
- J. All system components and related wiring shall be located with due regard for the minimization of induced electro-magnetic and electrostatic noise, for the minimization of wiring length, for proper ventilation, and to provide reasonable safety and convenience for the operator.
- K. All rack mounted equipment, with front panel controls, shall be provided with security covers to avoid tampering with preset levels. If specific security covers are not included in the equipment list, the Contractor will provide the manufacturer's security cover for each specified device or a suitable alternate.
- L. Every device shall be installed with regard for proper polarity. Absolute polarity shall be maintained through the entire Systems chain.

- M. Any electronic device which is connected to the patch bay must be balanced.

3.08 INITIAL ADJUSTMENT

- A. Verify all circuits and extensions for correct connection, continuity and polarity. Absolute polarity shall be maintained between all points in the system.
- B. Connector polarity shall be maintained except for terminations at equipment manufactured to other standards. In the event that manufactured equipment can be ordered with, or internally set to, various standards, the equipment shall be configured as follows:
 - 1. Polarity for XLR style connector shall be: Pin 2-high, pin 3-low, and pin 1-shield.
 - 2. Polarity for TRS style connector shall be: Tip-high, ring-low, and sleeve-shield.
- C. Make all adjustments and modifications so that the system is operational.
- D. Make all adjustments and modifications for system gain structure per recommendations of major component manufacturers.

3.09 VERIFICATION TESTS

- A. Confirm that each individual wire and cable run (whether in a rack or in conduit) is identified with a unique number. These numbers are affixed to both ends of each cable and are clearly visible. Provide a complete list of these numbers along with the termination location of each end of the wire run.
- B. Confirm that all system outputs are free of spurious signals including oscillations and radio frequency signals. A wide band oscilloscope shall be used to verify this condition.
- C. Confirm that the system is free of audible clicks, pops, and other noises when any operating control is activated, with or without input signal.
- D. For all microphone lines, tie lines, return lines and effect loudspeaker lines, confirm:
 - 1. Proper circuits appearing at each termination location.
 - 2. Proper circuits appearing at each jack bay position.
 - 3. Continuity of all conductors.
 - 4. Proper polarity is maintained.
 - 5. Absence of shorts between conductors within each circuit.
 - 6. Absence of shorts between circuit conductors and conduit.
- E. Confirm that loudspeakers and mountings are free of buzzes and rattles when the loudspeaker is swept with sine wave tones over its rated bandwidth at one-half its maximum rated power.
- F. For all permanently mounted loudspeaker terminations, provide impedance measurement of each pair of loudspeaker lines with all loudspeakers connected and all amplifiers disconnected. These measurements shall be documented as editable

tabular data listing impedance for each 1/3 octave band from 20 Hz to 20 kHz and shall be accurate to the nearest tenth of an Ohm.

- G. For all intercom terminations, confirm proper operation by initiating and receiving audio communication and call light.
- H. For each installed data network cable or fiber optic cable confirm conformance to the specified TIA/EIA performance standards.
- I. For all electronic devices mounted in racks and connected to patch bays, confirm:
 - 1. Every input and output is balanced.
 - 2. Proper polarity is maintained throughout the entire audio path.
 - 3. Tip connection of each TRS jack is connected to the positive terminal of each corresponding input or output.
- J. Confirm that there are no shorts between the Neutral and Isolated Ground conductors for each clean power circuit.

3.10 VERIFICATION TEST REPORT

- A. Acceptance Testing shall be performed by the Systems Designer during a period designated by the Architect. Contractor shall furnish a minimum of two (2) technicians for the acceptance testing period.
- B. The minimum time required for Acceptance Testing is two (2) working days of dedicated quiet for each performance venue and recording studio and two (2) days for the classroom/rehearsal room systems. Coordinate this time period so that free access, work lighting, and electrical power are available on the site.
- C. Ensure that Systems areas are in a clean and orderly condition ready for acceptance testing.
- D. Provide test equipment (meeting the following minimum specifications) on site, at all times during Acceptance Testing. Prior to Acceptance Testing, provide the Systems Designer with a listing of the specific equipment to be made available.
 - 1. Oscilloscope: 10MHz Bandwidth, Sensitivity – 1mV/cm.
 - 2. Digital Multi-meter: One percent (1%) accuracy.
 - 3. Function Generator: 1MHz Bandwidth, Distortion less than one percent (< 1%).
 - 4. Real Time Analyzer: 1/3 Octave with microphone.
 - 5. Pink Noise Source: 20 Hz – 20 kHz Bandwidth.
 - 6. Impedance Sweep Meter: 20 Hz – 20 kHz Range, 1 Ohm – 50 kOhm.
 - 7. Polarity Checker: Mic, line, or loudspeaker level.
 - 8. Note: Systems Designers may choose to supply their own test equipment.
- E. Be prepared to verify the performance of any portion of the system by demonstration, listening tests and instrumented measurements.

- F. Make additional mechanical and electrical adjustments within the scope of the work and which are deemed necessary by the Systems Designer as a result of the Acceptance Tests. This may include realigning of loudspeaker systems, changes in system gain structures, grounding, filtering or interfaces.
- G. Final acceptance will be contingent upon issuance by the Systems Designer of a letter of acceptance stating that the work has been completed and is in accordance with the contract documents.
- H. Contractor will bear any costs incurred for additional Systems Designer's time and expenses due to failure to have the system functioning in accordance with specification requirements at the times scheduled for Systems Designer's Acceptance Testing and tuning.

3.11 SYSTEM DOCUMENTATION

- A. Within thirty (30) days of the Acceptance Testing, prepare and submit a CD-ROM of the preliminary Operation and Maintenance manual for approval by the Systems Designer. Manual to include, at minimum, the following documents in PDF format:
 - 1. Table of contents.
 - 2. Written Guarantee and service policy.
 - 3. Basic power on/off and operational procedure.
 - 4. Copies of all shop drawings which have been updated to include any changes made during the installation process.
 - 5. All available manufacturers' operation and service literature for each major system component.
 - 6. One line signal flow diagram with all cable runs and patch points identified by alpha-numeric character.
 - 7. Copy of the Verification Test report.
 - 8. Copy of conduit riser diagram.
 - 9. Copy of the final tuning settings as provided by the Systems Designer.
- B. Systems Designer will review the above system documentation. Upon approval, Contractor shall prepare and submit to the Owner:
 - 1. Five (5) copies of the final Operation and Maintenance manual on CD-ROM.
 - 2. Two (2) hard copies of the final Operation and Maintenance manual printed and neatly bound.
- C. Provide framed copy of the as-built signal flow diagram to be mounted in the control room. This diagram shall have all cable runs and patch points identified by alpha-numeric character.

3.12 COMMISSIONING OF SYSTEMS AND EQUIPMENT

- A. Engage a factory-authorized service representative or technician who is familiar with this project to participate and assist, if necessary, in the functional performance testing of the equipment include in this Division with the Commissioning Agent.

3.13 FIELD QUALITY CONTROL

A. Local Sound Systems

1. Transmit audio signals, using various input sources, over local sound system speakers for determination of proper loudspeaker volume and clarity. Adjust all settings, controls for proper output to the satisfaction of the Authority.
2. For local sound systems, input circuits shall include all microphone outlets in the area, tuner, CD/MP3 player and audio input from VCR/DVD. Adjust feedback exterminator to achieve optimal result.
3. For all other local sound systems, test all microphone outlets and other input sources as shown on the drawings.

B. Distortion Test:

1. Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is three percent (3%) total harmonics.

C. Inspection:

1. Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.

D. Prepare test and inspection reports.

E. Include a record of final speaker-line matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.

3.14 EXAMINATION

A. Examine room conditions, ceiling and wall surfaces to assure they are in compliance with requirements and other conditions affecting installation and operation of Interactive Whiteboards projectors and speakers.

B. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to A/V cabling and other conditions affecting installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.15 CLEANING

A. Remove rubbish and debris. Installation contractor is not allowed you use the onsite dumpster and is responsible to discard their own debris off site.

- B. Clean installed items using methods and materials recommended in writing by manufacturer.

3.16 DEMONSTRATION

- A. Upon approval of the above test report by the architect and at a mutually agreeable time, demonstrate operation of each major component and of the complete installation. After demonstration, assist as required in acceptance testes.
- B. Listening Tests:
 - 1. Tests will include subjective evaluation by observers listening at various positions under various operating conditions of the system, intended to test its operation in conformance with its functional requirements.
- C. Equipment Tests:
 - 1. Perform any measurements of frequency response, distortion, noise or other characteristics and any operational tests deemed necessary by the Architect to determine conformity with these requirements.
 - 2. If the need for adjustment or modification becomes evident during demonstration and testing, continue working until the installation operates properly.
- D. Final Adjustments:
 - 1. Make control adjustments as directed by the Architect. Make a record of these control settings. Provide covers, caps, or shaft locks for controls not used in system operation.

3.17 COMPLETION

- A. Warranty service shall commence from 1 year after acceptance. Warranty service shall be provided during standard business hours within 24 hours after notice of concern.
- B. Labor and materials provided under scope of project shall be covered under 1 year warranty. Devices shall be free of defects from installation of manufacturer. If an item requires replacement, this shall be provided at no additional cost to owner. If items are abused or rendered inoperable from mis-use they shall not be covered under said warranty.
- C. A/V integrator shall provide "As Built" documents, 2 sets, to owner. This shall include equipment list, as installed, equipment manuals, and detailed drawings showing as installed wiring details.
 - 1. Provide a digital PDF copy of documentation on a USB Memory stick or CD/DVD for owner.
- D. Bidding contractor shall engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain each system described within this specification for the audio visual equipment. This training shall include ten (10) hours, in blocks of hours that shall be described by the Owner. Contractor shall ALSO provide (4) hours of training during actual performances by owner, given 5 days notice. These services shall be considered as part of the contract and at no additional fees charged to owner.

****End of Section****

SECTION 27 51 16

PUBLIC ADDRESS SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Drawings
 - 1. "T" Drawings – Technology Plans
- C. Related Sections:
 - 1. Section 27 05 28 – "Pathways for Communications Systems"
 - 2. Section 27 05 44 – "Sleeves and Sleeve Seals for Communications Pathways and Cabling".
 - 3. Section 27 53 13 – "Clock Systems".

1.02 SUMMARY

- A. Section Includes
 - 1. Central Control sound system
 - 2. Volume limiter/compressors
 - 3. Speakers
 - 4. Loudspeakers
 - 5. Preamplifiers
 - 6. Power amplifiers
 - 7. Equipment cabinet
 - 8. Equipment rack
 - 9. Telephone paging adapters
 - 10. Noise-operated gain controllers
 - 11. Battery backup power unit
 - 12. Conductors and cables

1.03 SCOPE OF WORK

- A. Description
 - 1. Refer to the phasing plan. This project shall be as phased approach as specified within the phasing section of this bid manual. The scope of work required as part of this project shall include a temporary service feed from the existing Public Address system to the new spaces. This temporary cabling shall be replaced with a permanent cabling during the phased renovations of this facility.
 - 2. This temporary feed shall include the following:

- A. Copper speaker cabling between the existing Public Address systems and all new spaces so that no occupied section of this facility shall not be without connectivity to the existing Public Address system.
 - B. After renovation to each section, the permanent cabling shall be utilized for all above connectivity. This new cabling is specified within the bid documents.
3. Contractor shall furnish and install a complete school wide sound, intercom system, hereafter referred to as "Sound System", including central control sound rack, loudspeakers, wiring, conduit, supports, boxes, equipment and accessories shown on the Drawings and as specified herein and as required to provide a complete system including but not limited to:
 - A. Administrative display phone with integrated 4x16 character display
 - B. Handsets
 - C. Call Switches
 - D. Classroom speaker(s), ceiling mounted
 - E. Call initiation switches capable of placing normal, urgent or emergency calls
 - F. Telemedia control of VCRs, DVDs, Video-On-Demand, and Blu-Ray
 - G. Built in Master Clock with 1024 events, 32 Schedules, including Daylight Savings Time, and 32 custom holiday events that can be assigned to any of the 8 multi-purpose zones
 - H. Wall-mounted paging horns
 - I. One built-in network interface port for system combining and LAN station-to-station calling and WAN access for district-wide all-calls and remote management
 - J. One built-in network interface port for first-time system configuration
 - K. Built-in Web Server for full system programming with Quantum Commander
 - L. Administrative Web-Browser Application for Programming and Day to Day System Operation
4. Local sound systems as described in specification 27 41 16.62 shall be interconnected with the main sound system described within this section, which shall be capable of overriding any local system for announcements made to areas covered by the local sound systems irrespective of whether the local systems are "ON" or "OFF".
5. This described sound system shall integrate with the PBX within the school for complete access to this system from any handset part of the PBX.
 - A. System can connect to the PSTN (Public Switched Telephone Network) by connecting it to analog CO trunks.
 - B. Telephone service with public utilities shall be arranged by the owner, in conjunction with the equipment supplier. Equipment supplier shall generate a one-page document that will provide the Owner with information concerning number of outside lines (minimum of 8, and a maximum of 960 per school, maximum of 99 Schools [facilities]).
6. This sound system shall accommodate this temporary space and all devices shall be re-used at a later date for the final build out of this facility.

1.04 SYSTEM PARAMETERS

- A. The communication system shall be a **Bogen Quantum Multicom IP hybrid IP**, and shall provide a comprehensive communication network between administrative areas and staff locations throughout the facility. Non-volatile memory shall store permanent memory and field-programmable memory. A system, which uses a battery to maintain system configuration information, shall not be acceptable.
- B. The system shall provide no less than the following features and functions:
1. Telephonic communication (complete with DTMF signaling, dial tone, ringing and busy signals, and data display) on administrative stations shall use two (2) wires. Systems that use more than two (2) wires for communication, tones and data display shall not be acceptable.
 2. Amplified-voice communication with loudspeakers shall use a shielded audio pair (shield can be used as one of the two (2) required conductors for administrative phone or call-in switch).
- C. The system shall be available in the following configurations:
1. MC2K Wall-mounted in a custom enclosure Quantum. Station capacity shall be from twenty-four to one hundred thirty (24-130) stations each Node. All stations shall have the ability to support displays.
 2. MC2KR Rack-mounted Quantum. Station capacity shall be from twenty-four to two hundred fifty (24-250) stations each Node. All telephone stations shall have the ability to support displays.
 3. QRC24 & QRC48 Compact Quantum Rack System. Station capacity shall be from twenty-four to forty-eight (24-48) stations per node. All stations shall have the ability to support displays, with an option to add up to eight (8) Central Office phone lines.
 4. 2223/2233 MC2KR Rack-mounted and integrated with Bogen Multi-Graphic Series 2223 or Series 2233 equipment. In this configuration, Quantum Multicom IP system station capacity shall be expandable up to two hundred forty (240) stations in increments of twenty-four (24) per node. All telephone stations shall have the ability to support displays. The Multi-Graphic system equipment provides the following: backup fail safe intercom and paging functions (Note: the systems operate independently; if one (1) were to fail, the other provides intercom for student safety), plus two (2) additional program channels, and additional Multi-Graphic functions. It shall be possible, by use of a separate call-in switch, to annunciate only to the Multi-Graphic portion of the system without using additional station ports within the Quantum Multicom IP system. For switch banks to work effectively the equipment must be centrally located for switch-bank operation.
 5. The above system configurations represent a single processor in the Quantum Multicom IP. Each processor can be combined with up to sixty-three (63) additional systems (nodes) for a total single facility capacity of up to sixteen thousand (16,000) stations.
- D. The system shall consist of any combination of the following: Administrative Display Phones, Administrative VoIP Phones, and Administrative Phones.
1. Staff Classroom Stations shall consist of wall- or ceiling-mounted loudspeakers with call-in switches or handsets.

2. Administrative phone stations shall consist of VoIP phones, display phones, or DTMF dialing 2500 analog-style telephone sets.
 - A. Up to five (5) Administrative Wall Displays may be added to the Administrative Station for large office areas.
 3. Administrative Display Phones, Administrative VoIP Phones, and Administrative Phones shall have the option of including a loudspeaker.
 4. All types of stations except administrative VoIP phones shall utilize the same type of field wiring. Future station alterations shall only require the station type to be changed and the proper software designation to be selected. Alterations shall not require field wiring or system head-end alterations. All field wiring and system head-end equipment shall support any type of station, at the time of installation. All contractor proposals shall reflect this capacity. Failure to submit and bid this project in this manner will be deemed as being in direct conflict of these specifications and will be rejected.
 5. There shall be no limit to the number of administrative display stations within the total capacity of the system including nodes. Systems that require different head-end equipment to make admin phone work shall not be acceptable.
 6. It shall be possible at any time to change the type of station at any location without equipment or wiring changes except for administrative VoIP phones that utilize existing LAN connections. Systems that limit the quantity of each station type or require future additional equipment and/or system expansion to provide additional administrative telephones shall not be accepted as an equal.
- E. The system shall be a global switching system, providing up to five hundred twelve (512) unrestricted simultaneous private telephone paths per facility. The system shall also be capable of providing up to five hundred twelve (512) amplified intercom paths per facility. One (1) amplified intercom path shall automatically be provided with each increment of twenty-four (24) stations of system capacity. All hardware, etc., required to achieve the necessary number of amplified-voice intercom channels for this system shall be included in this submittal. Amplified-voice intercom channels shall provide voice-activated switching. Systems requiring the use of a push-to-talk switch on administrative telephones shall not be acceptable. There shall be an automatic level control for return speech during amplified-voice communications. The intercom amplifier shall also provide control over the switch sensitivity and delay times of the VOX circuitry.
- F. The system shall provide 911 Dial-Through with specific outside line(s) dedicated only for this function to ensure that the line is available all the time for 911 calls. The 911 Dial-Through is available to any station that can dial.
1. The 911 CO lines will be pre-configured and reserved. If the 911 reserved lines are busy, the normal CO lines will be connected to route the 911 calls. If all the normal CO lines are busy, the ongoing call shall be disconnected and the 911 call shall be placed.
 2. When 911 is dialed from a Administrative VoIP Phone or Administrative Phone its Administrative Display Phone or Wall Display will receive a message that that room dialed 911.

- G. Emergency calls from staff stations shall receive prompt attention. An alternate destination in case the emergency call does not get answered at the primary location shall be configured as follows:
1. Staff-generated Emergency calls shall be treated as the second highest system priority. All Emergency calls shall announce at the top of the call queue of their respective administrative display phone. Should that emergency call go unanswered for fifteen (15) seconds, the call shall be re-routed to an alternate speaker station then a tone prompts the caller to make a verbal call for help. During the transfer, the original administrative telephone shall continue to ring the distinctive Emergency Ring. Should the Emergency Transfer to Station have an associated administrative telephone, it too shall ring the distinctive Emergency ring.
 2. The Emergency Transfer to Station shall be field programmable.
 3. Should the original administrative display phone be engaged in a non-emergency conversation, its conversation shall be automatically terminated, indicated with an alert tone, and then reconnected to the station that generated the Emergency Call.
 4. Should the administrative display phone be engaged in an emergency conversation, successive emergency calls shall log into the call queue as well as transfer to the Emergency Transfer Station for their verbal call for help. Upon termination of the initial emergency conversation, the next one shall immediately ring the administrative telephone.
 5. Systems failing to transfer unanswered Emergency calls or failing to immediately connect to the administrative display phone shall not be deemed as equal.
- H. There shall be a System-Wide Facility Emergency All-Call feature. The Emergency All-Call shall be accessed from designated administrative phones or by the activation of an external contact closure which shall give the third audio program input emergency status. The Emergency All-Call function shall have the highest system priority and shall override all other loudspeaker-related functions including Time Tones, Normal All-Call or Zone Pages or Audio Distribution.
1. Considering that emergency calls are to be treated with the highest level of concern. Systems which do not regard Emergency-All-Call page from an administrative station with the highest priority shall not be deemed as equal.
 2. Upon picking up the receiver and dialing "9", a menu shall appear on the display prompting the user to enter each subsequent digit. In this way, the user shall not be required to memorize complicated key sequences in order to access emergency functions.
 3. The Emergency All-Call shall capture complete system priority, and shall be transmitted over all speakers in the facility. It shall also activate an external relay, which can be used to automatically override volume controls and other systems.
 4. Systems without Emergency All-Call, or systems with All-Call that cannot be activated by external means, or which do not capture complete system priority or activate an external relay, shall not be acceptable.
- I. There shall be at least four Dedicated Emergency Alarm Tones. Each may be accessed by dialing a three-digit number from designated administrative display phone. These

emergency tones should be separate from the time tones. Systems using external alarm generators, or having less than four emergency alarm tones shall not be acceptable.

1. Upon picking up the receiver and dialing "9", a menu shall appear on the display prompting the user to enter each subsequent digit. In this way, the user shall not be required to memorize complicated key sequences in order to access Emergency Alarm Tones.
- J. There shall be four (4) External-Function Relay Driver Outputs, accessible from designated Quantum Commander User or Administrative Display Telephones by dialing a four-digit number. These outputs remain set until accessed and reset at a later time. The user shall have the ability to review the status of each relay driver. A plain English menu, prompting the user through the fields without requiring the user to remember any dialing sequences shall support this feature. Systems that require the user to remember complicated dialing schemes or prompt the user via cryptic commands shall not be deemed equal.
1. The stations shall be capable of being programmed for security contact relays for use with magnetic locks, motion detectors, cameras or any low-voltage, dry contact creating device. System using security stations for control of external functions shall not be acceptable.
 2. Upon picking up the receiver and dialing "9", a menu shall appear on the display prompting the user to enter each subsequent digit. In this way, the user shall not be required to memorize complicated key sequences in order to access external relay functions.
- K. There shall be a program-material interface included with each node, which shall accept up to four (4) program input modules. Systems requiring an external program source interface shall not be acceptable.
- L. There shall be an outside line feature. The circuitry shall interface with the station ports of an external telephone system, and shall provide facilities for up to nine hundred sixty (960) incoming lines per facility which shall be designated by the user to ring "day" and "night" administrative display stations or administrative stations. Where an administrative display station is designated to receive outside line calls, the phone shall ring with a unique tone and the outside line number shall appear on the display panel. The option shall also provide the ability to make outside line calls from Administrative Display Stations or Administrative Stations. This ability shall be programmable for each phone and there shall be thirty-two (32) Classes of Service available to any station. This feature shall be capable of supporting DID, DISA, and a Security DISA function.
1. Cellular system access for Security is of the utmost concern. Wireless security page offers a password-protected Security DISA feature that shall be accessible only from authorized Police, Fire, Emergency personal or an off-premise security office, which monitors the facility's security system. It shall function as follows: upon confirmation of the password DISA number, the system shall allow security personnel to dial access any station and monitor the activity without pre-announce tone or the privacy tone. This will then allow the security office to determine exactly what the conditions are in the station and the actions need to be taken.
- M. The system shall provide for field-programmable three-, four-, five-, or six-digit architectural station numbers.

- N. There shall be an automatic level control for return speech during amplified-voice communications.
- O. Each station loudspeaker shall be assignable to any one, any combination, or all of sixty-four (64) Multi-purpose zones or any of the sixteen thousand (16,000) hard-wired zones per facility.
1. Each station loudspeaker shall be assignable to any one (1), any combination, or all of sixty-four (64) Multi-purpose zones. Systems with less than sixty-four (64) Multi-purpose zones shall not be acceptable.
- P. There shall be thirty-two (32) Flexible Time-Signaling Schedules with a total of one thousand twenty-four (1024) user-programmed events per facility. Each event shall sound one (1) of user-selected tones or external audio. It shall be possible to assign each schedule to a day of the week, or manually change schedules from an authorized Quantum Commander User via Web browser or MCDS4 phone. Systems, which do not provide a minimum of thirty-two (32) flexible time-signaling schedules or a choice of eight (8) time tones plus external audio, shall not be acceptable.
- Q. An internal program clock (with battery backup) shall be included, allowing a total of one thousand twenty-four (1024) user-programmed events per facility. It shall be possible to synchronize the internal program clock with an external master clock. Systems, which do not provide an internal program clock and/or can not synchronize with an external master clock to meet these specifications, are not equal.
1. There shall be thirty-two (32) flexible time-signaling schedules. It shall be possible to assign each schedule to a day of the week, or manually change schedules from an authorized Quantum Commander User via Web browser on the LAN or WAN. Systems that require external equipment or server to perform these functions are not considered equivalent.
 2. The built-in Master Clock corrects time by accessing the LAN NTP time server.
 3. The Quantum Processor is capable of adjusting the Daylight Savings Time automatically.
 4. Each event shall be able to be directed to any one (1) or more of the sixty-four (64) Multi-purpose time-signaling zones.
 5. Each of the sixty-four (64) Multi-purpose zones shall have a programmable "tone duration" unique unto itself. For example: the gymnasium can receive a time tone for ten (10) seconds while the rest of the facility receives a tone for five (5) seconds.
 6. Each event shall sound one of eight (8) user-selected tones or external audio. Each event may utilize a different custom tone. It shall be utilized to send the gymnasium, shop classes, and pool (if necessary), a separate time tone to indicate "clean up." Minutes later the entire facility can then receive the same time tone to indicate class change.
 7. Each of the eight (8) Distinct Time Tone Signals may be manually activated by selected Administrative Display Phones or an authorized Quantum Commander User via web-browser. These tone signals shall remain active as long as the telephone remains off-hook, or until canceled from the keypad or Quantum Commander.

- A. Upon picking up the receiver and dialing "9", a menu shall appear on the display prompting the user to enter the next digit. In this way, the user shall not be required to memorize complicated key sequences in order to access manual time-tone functions.
 - B. Systems that do not provide at least thirty-two (32) flexible time signaling schedules or do not provide automatic activation of schedules shall not be acceptable.
- R. There shall be a zone-page/all-page feature that is accessible by selected administrative VoIP phones and administrative phones.
- 1. There shall be automatic muting of the loudspeaker in the area where a page is originating.
 - 2. There shall be a pre-announce tone signal at any loudspeaker selected for voice paging.
- S. There shall be a voice-intercom feature that is accessible by selected administrative phones, administrative VoIP phones and all administrative display phones.
- 1. There shall be a privacy tone every sixteen (16) seconds to signal at any loudspeaker selected for amplified-voice communication is in progress.
 - 2. There shall be a pre-announce tone signal at any loudspeaker selected for voice-intercom communication.
 - 3. Privacy and pre-announce tone signals shall be capable of being disabled during system initialization.
 - 4. There shall be an automatic switchover to private telephone communication should the person at the loudspeaker pick up his handset.
 - 5. By picking up the receiver and dialing the first digit of the number of the station to be called, that number shall appear on the display along with a loudspeaker symbol, prompting the user to enter the next digits. There should be no confusion as to type of conversation, whether speaker/intercom or telephonic to be established.
- T. There shall be a telephonic communication feature, which is accessible by all Administrative VoIP Phones, Administrative Phones, and Administrative Display Phones.
- 1. There shall be an audible ring signal announcing that a call has been placed to that station.
 - 2. Upon picking up the receiver and dialing * (star), a telephone symbol shall appear on the display, prompting the user to enter the number of the station to be called. There should be no confusion as to type of conversation, whether speaker/intercom or telephonic to be established.
 - 3. There shall be an automatic disconnect of Staff Handsets left off-hook to prevent them from tying up communications channels. The station shall receive a busy signal and shall automatically disconnect after forty-five (45) seconds. Systems shall also be capable of doing off hook emergency call-in.
 - 4. There shall be an automatic disconnect of Administrative Display Phones and Administrative Phones to prevent them from tying up communications channels. When a phone goes off-hook and does not initiate a call within ten (10) seconds,

- the station shall receive a busy signal and shall automatically disconnect after forty-five (45) more seconds.
5. Staff and Administrative Phone Stations may be programmed to ring an Administrative Display Phone during day hours and another Administrative Display Phone during night hours. Day and Night Hours shall be user-programmable. Assignment of Staff Stations shall not be restricted to any particular Administrative Station. Systems that limit the number and assignment of staff call-in to particular Administrative Display Station of Administrative Stations shall not be acceptable.
- U. Administrative VoIP Phones shall receive dial tone upon going off-hook. Outgoing calls are made by dialing the desired station. Incoming calls can be directed to the telephone or to the associated loudspeaker for a hands-free reply. There shall be a switchover from loudspeaker to private telephone communication when a person picks up the handset and dials ##### and enter (check mark).
1. Administrative VoIP Phones shall be able to make a normal call to any Administrative Display Phone by dialing the number. They shall also be able to initiate an Emergency Call by dialing ****. Emergency Calls shall ring the Designated Day/Night Administrative Display Phone. The system shall provide for each station to have a PIN Numbers. By dialing the PIN at any system telephone, the administrator shall have access to emergency paging regardless of the restrictions on the particular phone being used.
- V. Administrative Phones MCESS or MCWESS shall receive dial tone upon going off-hook. Outgoing calls are made by dialing the desired station. Incoming calls can be directed to the telephone or to the associated loudspeaker for a hands-free reply. There shall be an automatic switchover from loudspeaker to private telephone communication should the person pick up the handset.
1. Administrative Phones shall be able to make a normal call to any Administrative Phone by dialing the number. They shall also be able to initiate an Emergency Call by flashing the hook switch four (4) times. Emergency Calls shall ring the Designated Day/Night Administrative Display Phone and then their speaker will be connected to the emergency link station if not answered within a predetermined time period. The system shall provide for each station to have a PIN Numbers. By dialing the PIN at any system telephone, the administrator shall have access to emergency paging regardless of the restrictions on the particular phone being used.
- W. Administrative Display Phones shall be equipped with a 4x16 character alphanumeric display panel.
1. Administrative Display Phones shall receive dial tone upon going off-hook. Outgoing calls are made by dialing the desired stations. Incoming calls can be directed to the telephone or to the associated loudspeaker for a hands-free reply. There shall be an automatic switchover from loudspeaker to private telephone communication should the person pick up his handset.
 2. The display shall normally show the time of day and day of week, the current time signaling schedule, and the numbers of up to four (4) stations calling in along with the call-in status of each station (normal, urgent, emergency). When dialing from

- the Administrative Display Phone, the display shall indicate the station number and type of station (loudspeaker or handset) being dialed.
3. The display shall also provide user-friendly menu selections to assist the operator when paging and distributing program material. Displays shall be in English with internationally recognized symbols for maximum ease of use. Systems, which require the operator to memorize long lists of operating symbols or control codes, shall not be acceptable.
 4. Administrative Display Phones shall be programmable for one (1) of three (3) station types for system access, as follows:
 - A. Shall permit dialing any station in the system; turn program material on/off at their location; scroll, erase and auto-dial call-waiting queue; make conference calls and transfer calls; call forward to other administrative stations; make all-zone pages and emergency all-zone pages; have access to outside lines and be designated to receive outside line calls.
 - B. Select and distribute or cancel program material to any combination of stations, paging zones, or all zones; set/reset alarm/external functions and zone paging.
 - C. Bump or join a conversation in progress, manually initiate time tones.
 5. Program selection, and its distribution or cancellation shall be accomplished from a designated administrative display telephone, with the assistance of the menu display system. Distribution and cancellation shall be to any one, or combination of speakers, or any zone(s), or all zones. It shall be possible to provide three program channels at the same time.
 6. It shall be possible, via an Administrative Display telephone, to manually initiate any of eight (8) tones or any of the emergency tones. The tones shall be separate and distinctly different from the emergency tones. The tone selected shall continue to sound until it is canceled, or until the administrative display phone is placed back on-hook.
 7. Each Administrative Display Phone shall maintain a unique queue of all stations calling that particular phone.
- X. System programming shall be from an authorized Quantum Commander User via Web browser. All system programming data shall be stored in nonvolatile memory. A valid username and password shall be required to gain access to the following programmable functions:
1. Station Initialization shall be accomplished from an authorized Quantum Commander User via web browser. All station initialization data shall be stored in nonvolatile memory. A password (separate from the password necessary for system programming) shall be required to gain access to the following station initialization parameters:
 - A. Programming and diagnostics shall be built into the Quantum Commander web server browser and be accessible only by authorized personnel. Diagnostics shall indicate passes and failures of system memory, system clock, all audio busses, tone generators, DTMF generators and decoders and the integrity of the field wiring.
 - B. Systems not capable of supporting web-based diagnostics and any computer interface for programming and diagnostics or supportive of built-in diagnostics for the end user shall not be deemed as equal.

- C. Systems that require a serial to Ethernet converter requiring additional software on pc for programming are not deemed as equal.

 - Y. Rollover EOL (End-Of-Line Device)
 - 1. This feature shall be supported for all the Stations (Admin Display phone, analog phone or handset) configured with a loudspeaker. Based on the dialed sequence, intercom or telephonic call will be connected to the corresponding telephone/handset or speaker.
 - 2. If a handset station, configured with this feature, is busy when an Admin User calls the station, the call shall be rolled over to the associated speaker. If the speaker is also busy in this case, then the Admin can bump the conversation if enabled in CoS for the admin calling.
 - 3. Rollover End-of-Line features is only available for the following station types:
 - A. Admin Phone and Speaker.
 - B. Analog Phone and Speaker.
 - C. Handset and Speaker.
 - 4. For calls initiated by a call switch or a non-dial handset, rollover to the admin speaker shall not happen.

 - Z. Admin AAA Group (Always An Answer)
 - 1. This is an Administrative Display Phone feature. This feature shall be programmed from the Commander software. A maximum of ten (10) Administrative Display Phones will be supported in an Admin Group and there shall be a maximum of thirty-two (32) Admin Groups per facility.
 - 2. Once the Admin Group is set:
 - A. For normal calls, if the primary Day/Night Admin Phone is busy/no answer, all the phones in the Admin Group shall ring.
 - B. For emergency calls, if the primary day/night phone does not answer, all the phones in the Admin Group shall ring.
 - C. On no answer from any of the admin phones and if the emergency announce link is configured, the call shall be transferred to the emergency announce link as per the existing procedures. Administrative VoIP Phones do not have the emergency announce link functionality.
 - D. On answer from any of the Admin Group Phones, all the other phones shall stop ringing.
- 1.05 DEFINITIONS
- A. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.
 - B. VU: Volume unit.
 - C. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.

1.06 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated with each other, using input from installers of the items involved.
- C. Shop Drawings: For supports and seismic restraints for control consoles, equipment cabinets and racks, and components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. The Contractor shall submit a complete wiring diagram, dimensional and descriptive Drawings of all equipment, in quadruplicate, for approval. Drawings of the Central Control Rack shall indicate the location of equipment, and shall provide full descriptive details of all equipment including methods of mounting equipment, wiring details, etc. These Drawings and Product Data shall fully detail each item and give complete performance and operating characteristics of the item.
 - A. Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
 - B. Console layouts.
 - C. Control panels.
 - D. Rack arrangements.
 - E. Calculations: For sizing backup battery.
 - F. Retain subparagraph below if equipment includes wiring.
 - G. Wiring Diagrams: For power, signal, and control wiring.
 - H. Identify terminals to facilitate installation, operation, and maintenance.
 - I. Single-line diagram showing interconnection of components.
 - J. Cabling diagram showing cable routing.
- D. Delegated-Design Submittal: For supports and seismic restraints for control consoles, equipment cabinets and racks, and components indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of supports and seismic restraints for control consoles, equipment cabinets and racks, and components.
- E. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated with each other, using input from installers of the items involved.
- F. Qualification Data: For qualified Installer.

- G. Seismic Qualification Certificates: For control consoles, equipment cabinets and racks, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- H. Field quality-control reports.
- I. Operation and Maintenance Data: For public address and mass notification systems to include in emergency, operation, and maintenance manuals.
- J. Programming code and password for the system.
- K. Test results and certificate of completion of testing to the existing PA system.
- L. Two (2) Internal Wiring Diagrams of the central control sound rack, identifying
 - A. All terminations at the terminal strips: speakers and their locations.
 - B. Locations and interconnection between/among components within the rack.
- M. Submit a numbered Certificate of Completion for installation, programming, and service training, which identifies the installing technician(s) as having successfully completed the technical training course(s) provided by the system manufacturer.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 1. Personnel certified by NICET as Audio Systems Level II Technician.
- B. All items of equipment shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.
- C. The contractor shall be an established communications and electronics contractor that has had and currently maintains a locally run and operated business for at least 5 years. The contractor shall be a duly authorized distributor of the equipment supplied with full manufacturer's warranty privileges.
- D. The contractor shall show satisfactory evidence, upon request, that he or she maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system. The contractor shall maintain at his or her facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.

- E. 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.
- F. Comply with NFPA 70.

1.08 SAFETY / COMPLIANCE TESTING

- A. The communications system shall bear the label of a Nationally Recognized Testing Laboratory (NRTL) such as ETL, and be listed by their re-examination service. All work must be completed in strict accordance with all applicable electrical codes, under direction of a qualified and factory approved distributor, to the approval of the owner.
- B. The system is to be designed and configured for maximum ease of service and repair. All major components of the system shall be designed as a standard component of one type of card cage. All internal connections of the system shall be with factory-keyed plugs designed for fault-free connection.
- C. The printed circuit card of the card cage shall be silk-screened to indicate the location of each connection.

1.09 COORDINATION

- A. Coordinate layout and installation of system components and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - MANUFACTURERS

- A. Approved manufacturers for Public Address sound systems:
 - 1. Bogen Inc
 - 2. No substitutions allowed as the district has standardized on this manufacturer.
 - 3. All sound system components shall be the product of the aforementioned companies and those indicated in the specifications. All systems and equipment shall fully meet the requirements of these Specifications.
- B. All systems and equipment, including those mentioned in the specifications by model/catalog numbers, shall nevertheless be specially modified to meet all the requirements of these specifications.
- C. The intent of this product is to establish a standard of quality, function and features. It is the responsibility of the bidder to insure that the proposed product meets or exceeds every standard set forth in this specification.

PART 3 - PRODUCTS

3.01 PUBLIC ADDRESS SYSTEM

A. System: **Quantum Multicom IP** manufactured by Bogen Communications, Inc., Ramsey, NJ and Made in the United States of America.

B. System Overview:

1) The Quantum hybrid IP intercom must be capable of supporting the existing **Multicom 2000** hardware and functions as well as the new features across the Quantum Processor's interfaced over the LAN. The VoIP capabilities of the QSPC1 Quantum Processor Card will enable the support of the features across the various processors' nodes. The sections below cover how the system will handle each of the existing and the new features in the QSPC1 product. Systems that do not allow the reuse of existing equipment or are not backwards compatible shall not be deemed acceptable. Systems that don't allow processors/nodes to be seamlessly integrated via the LAN are not considered equal.

2) **Quantum Multicom IP**

- a) The Quantum facility shall have a minimum of one (1) node/processor and a maximum of up to sixty-four (64) interconnected nodes/processors. A maximum of up to ninety-nine (99) facilities can be interconnected into a Quantum hybrid IP district.
- b) The station numbers, program buses, etc. shall be identified with a QSPC1#, Station card# and port# or QSPC1#, program#.
- c) Audio Information will be transmitted between the processors on the LAN using VoIP technology. Quantum will utilize all of the existing **Multicom 2000** hardware except the current processor card. Thus making **Quantum Multicom IP** backwards-compatible with existing **Multicom 2000** systems.
- d) The processor software shall be upgradeable via Quantum Commander. After rebooting the nodes the software upgrade will be complete. If for some reason the newly installed software will not boot properly, the system shall revert to the previous working software load.
- e) It shall be possible for Quantum schools to make 'station-to-station' calls and 'inter-facility All-Call paging' to a single facility or all Quantum facilities in a district using VoIP technology. Systems that require software to be loaded onto an external server or computer to make 'station-to-station' calls and 'inter-facility All-Call paging shall not considered equivalent.
- f) The primary QSPC1 shall be configured to act as a VoIP Call Manager for facility point-to-point calls. Using Quantum Commander, every facility shall be configured with the IP addresses of the primary QSPC1 systems of all the other known facilities (maximum of ninety-eight (98) additional), and an organizationally private multicast IP address is to use the 239.0.0.0/8 scope. Additionally, multicast best practices recommend avoiding 239.0.0.x, 239.0.1.x, and 239.128.1.x address scopes which shall be used for facility and inter-facility paging.

- g) The maximum number of simultaneous inter-facility intercom calls supported is based on the actual performance of the WAN and the CPU load. The voice quality of the inter-facility calls may vary based on the WAN conditions the average network intercom call uses around 20 Kbps (uni-cast) audio distribution (i.e. mp3 player, AM/FM tuner and or CD player) uses around 250 Kbps (multi-cast).
 - h) The system shall facilitate the playing of audio clips repetitively played until stopped by the Quantum Commander User an administrative display phone MCDS4 or a dry contact closure.
 - i) A built-in Master Clock, with battery backup, shall be included to automatically control class change or other signals. The Master Program Clock shall have one thousand twenty-four (1024) events that may be programmed into any of the thirty-two (32) time signaling schedules, and/or thirty-two (32) flexible holiday schedules. The schedules shall be nameable for easy selection when assigning schedules to days or in the event of an override. Systems that rely on external master clock shall not be considered equivalent.
 - j) Network Time Synchronization. The system shall be capable of periodic update/synchronization of the processor's time with a Network Time Server via the school's LAN network. The Quantum processor card checks the NTP Server time every hour. Systems that do not provide Network Time Synchronization will not be deemed equivalent.
 - k) Network Failure – in the event of a network failure the multi-node facilities processors will continue to work autonomously providing the facility with all scheduled events stored in each of the nodes local non-volatile memory and ability to connect an administrative phone to the local node for paging in the event of network failure. Systems that do not provide autonomous operation shall not be considered equal.
 - l) Multi-Node Survivability – the system shall provide Multi-Node Survivability in the event of a processor card failure. If either the primary processor or secondary processor fails the remaining processor will take over as primary. Systems that do not provide Multi-Node Survivability shall not be considered equivalent.
 - m) Station in a Multi-Node system shall support any or all station types specified in section 2.02 A. 8. Systems that don't support all types of station or require different head end equipment are not considered equivalent.
- 3) Quantum Commander
- a) The processor utilizes a web-based programming tool. The Quantum Commander is built into the QSPC1 processor card and upon boot up, users can login to the Quantum Commander Web Server via their web browser. Systems that require software to be loaded onto an external server/pc for web-based programming shall not considered equivalent. Systems that require com port redirector software or serial to Ethernet adapters are not deemed equal.

- b) The Quantum Commander shall be divided into three (3) access levels depending on user access credentials. Systems that do not provide at least three (3) Levels of access are not equivalent. The three (3) levels are:
- c) Only the Administrator and Technician shall have access to add/delete/modify the database objects.
- d) Users shall have display only access to see the data objects that include configuration, alarms, and performance data and perform certain operations based on the user's CoS (Class of Service).
- e) The following Menu Items must be available on the Multicom IP Quantum Commander:
 - 1) File - Open Database, New System, Save, Delete, Report and Exit, Upload Database, Download Database, Download Software, Diagnostics, Tones and Announcements, Relay Configuration, Program Distribution, Media Assignment, List Passwords, Add Password, and Change Password.

C. Central Control Console

- 1) Rack-mounted equipment shall be Bogen Model TCPER
 - a) 77 inch rack.
- 2) MCRMP/MCMP/QRC24-48 (Compact Rack System)
 - a) Rack Mount full, Mini-System, or Wall Mount panel. Shall include the following components:
 - 1) Quantum Processor Card QSPC1.
 - 2) Analog Card.
 - 3) Station Card.
 - 4) Telephone Interface Card.
 - 5) 5 volt/12 volt Power Supply
 - 6) 26 volt Power Supply(s).
 - 7) Audio Program Module Interface Assembly.
- 3) MCRMF/MCMF/QRC24-48
 - a) MCRMF Rack mounting mainframe. Includes built-in ventilation fans and the following circuit cards:
 - 1) Quantum Processor Card.
 - 2) Analog Card.
 - 3) Station Card.
 - 4) Telephone Interface Card.
 - 5) Ribbon Cable Assembly.
 - b) MCMF Wall Mount mounting mainframe. Utilizes convection cooling and the following circuit cards:

- 1) Quantum Processor Card.
 - 2) Analog Card.
 - 3) Station Card.
 - 4) Telephone Interface Card.
- 4) QRC24/QCR48 Compact Quantum Rack System Mainframe (one (1) per Mini-System). Includes built-in ventilation fan and the following circuit cards:
 - a) Quantum Processor Card.
 - b) Analog Card.
 - c) Station Card.
 - d) Telephone Interface Card.
 - 5) MCRRP/MCRRC/MCRC
 - a) Ribbon Cable Assembly.
 - 6) Program Sources
 - a) Tape Player & AM/FM Tuner.
 - b) 5-Disc CD Player.
 - c) AM/FM Tuner.
 - d) Desktop Paging Microphone.
 - 7) Power Amplifiers
 - a) 250-Watt Amplifier.
 - 8) Station Equipment
 - a) Administrative Display Phone.
 - b) Administrative Desktop Phone.
 - c) Secure Call - Call Assurance Call-in Switch.
 - 9) Additional Equipment required
 - a) Telephone Access Card.
- D. Administrative Display Phone
- 1) Administrative Display Phones shall be Bogen **Model MCDS4**. The administrative telephone display panel shows the time of day and day of week, the current time signaling schedule, and the station numbers and call-in priority of staff stations that have called that particular station. A 3-key response is used to scroll the display, and answer or erase normal, urgent, and security calls. Depending upon the system programming, an administrative station can use display menus to activate zone pages, alarm signals and external functions, as well as select program sources and distribute or cancel a program to any or all speakers or zones.

- 2) Administrative Display Phones shall have the ability to dial and have the option of dialing either the loudspeaker or phone at each station location. The system shall automatically switch from phone-to-intercom communication to phone-to-phone communication when the staff handset or enhanced staff phone on the receiving end of the call is lifted.
- 3) The Administrative Display Phone shall display the classroom number of any station that calls 911. This feature will notify the main office when a classroom has dialed 911 emergency centers so that administrators can direct emergency personnel to the correct physical location in the building when they arrive. Systems that do not provide this feature will not be deemed equal.
- 4) Administrative Display Phones shall have the ability to manually override the active schedule in the facility. Systems that do not have the ability to override the schedule via the administrative phone are not equal.

2. SPEAKERS

- A. Unless otherwise noted, this speaker shall be used as part of the speaker assemblies specified below.
- B. Classroom Speakers shall be Bogen:
 - 1) Ceiling Speakers: **CSD2X2** Drop-In Ceiling Speakers
 - 2) Wall Speakers: **MB8TSQ/SL** Metal Box Speakers
- C. Hallway Speakers shall be Bogen:
 - 1) Ceiling Speakers: **S86T725PG8W** Drop-In Ceiling Speakers
- D. Flush mounted ceiling speaker assembly mounting accessories:
 - 1) Bogen **#RE84** - Ceiling Speaker Enclosure or approved equal – The protective enclosure for the 8 inch cone-type loudspeakers shall be a Bogen **Model RE84**, or equivalent, designed for recessed installations. It shall be constructed of one-piece heavy-gauge steel, and shall include a speaker-mounting ring. A foam insert shall be permanently attached to the inner surface, to prevent metallic resonance. Four (4) combinations ½-¾ inch conduit knockouts shall be provided at 90 degree intervals, and the unit shall be finished in a rust-resistant primer coating. The dimensions shall be: 12¼ inch dia. x 4½ D.
 - 2) Bogen **#MR8** - Mounting Ring or approved equal – The plaster ring shall be a Bogen **Model MR8**, or equivalent, circular cold-rolled steel unit that will mount any Bogen ceiling grille. It shall be finished in a rust-resistant primer coating, and the dimensions shall be: 12 inch dia. x ¾ inch D.
 - 3) Bogen **#TB8** - Tile Bridge or approved equal – The load-bearing T-bar support shall be a Bogen **Model TB8**, or equivalent, capable of sustaining the weight of an 8 inch speaker, grille and protective enclosure in suspended ceiling construction. It shall be manufactured of steel and shall be finished with a rust-resistant galvanized coating. The unit shall measure: 23¾ inch W x ¾ inch H x 14½ inch D.
 - 4) Locker/Mechanical Room Speakers shall be Bogen:

- a) **FMH15T** mounted in **BBSM6** surface-mounted vandal-resistant enclosure/BBFM6 flush-mounted vandal-resistant enclosure with **FMHAR8** adapter ring and **SGHD8** heavy duty grille.
- 5) Outdoor Horn Speaker shall be Bogen:
 - a) **KFLDS30T** Wide Dispersion Reentrant Horn Loudspeakers
- 6) Hallway and Common Area Speakers shall be Bogen:
 - a) **HFCS1** High-Fidelity Ceiling Speakers
- 7) Auditorium and Gym Speakers shall be Electro Voice:
 - a) The loudspeaker shall be a two-way system consisting of two 6" (152mm) low-frequency transducers, a 1" (25mm) high-frequency transducer with a Coherent Coverage Waveguide, and a frequency-dividing network installed in a vented, line-array enclosure. The network shall include a passive limiter for both the low-frequency and high-frequency transducers. The loudspeaker system shall meet the following performance criteria: Power handling, 300-Watts of EIA RS-426A continuous pink noise (6 dB crest factor); Frequency response, 62 Hz - 20 kHz (-10 dB from rated sensitivity); Pressure sensitivity, 94 dB at one watt, 200 Hz -10 kHz at one meter; Impedance, 8 ohms nominal, 6 ohms minimum. The high-frequency transducer shall drive a waveguide to cover evenly 100° horizontally by 90° vertically. The enclosure shall be molded of acrylic butyl styrene. The enclosure shall be 16.5" (419mm) high, 9" (228mm) wide, 11.75" (298mm) deep. The finish shall be a paintable black or white. The grille shall be zinc plated, powder coated for corrosion resistance, and restrained with a safety leash. The loudspeaker shall be adjustable over a range of 100° horizontally and 90° vertically. The support bracket shall be low profile and integral with the enclosure. The system shall be weather resistant to MIL Spec 810 and IEC 529 IP 34 test conditions.
 - b) The surface mount loudspeaker shall be the Electro-Voice EVID model 6.2T.
- 8) Volume control for speakers:
 - a) Provide a volume control for speaker in each location indicated within the architectural plans.
 - b) Volume control shall be equipped with an autotransformer and ten (10) steps of attenuation, wall mounted to a single-gang bushed stainless steel plate at 4'-0" A.F.F.
 - c) Power rating shall be 10 watts. Input voltage shall be 25 volts or 70 volts. Attenuation range shall be 36 dB. Insertion loss shall be 0.5 dB or less.
 - d) Volume control shall be Bogen **#ATP10A** or approved equivalent.

B. Wire Guards

1. A guard shall be provided for each speaker where indicated on the Drawings.
2. The guard shall be rectangular in shape, constructed with 9-gage steel rods, zinc plated, epoxy finish; Color: White.
3. Guards shall be securely fastened to the wall.

3.02 CABLING

- A. The Contractor shall provide wiring in raceway for the proper operation of the sound systems as called for in these Specifications, or as shown on the drawings. The types of cables required are as follows:
1. Loudspeaker Cable: It shall contain three (3) 22 AWG stranded tinned copper conductors (two (2) aluminum-polyester shielded and one (1) unshielded), plus a #22 AWG copper drain wire in a chrome PVC jacket. Conductors shall be polyethylene insulated with 0.014 inch thickness. Jacket thickness shall be 0.028 inch and overall outer diameter 0.21 inch. Loudspeaker cable shall be Belden 8763 or approved equal.
 2. Microphone Cable: Cable shall consist of one (1) pair of 20 AWG stranded, tinned copper conductors, plus a #20 stranded drain wire in a chrome PVC jacket. Conductors shall be polyethelene insulated and aluminum-polyester shielded. Microphone cable shall be Belden No. 8760 or approved equal.
 3. UL-listed plenum rated cable shall be installed in environmental air spaces, including plenum ceiling.

3.03 RACEWAYS

- A. Conduit and Boxes: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
1. Outlet boxes shall be not less than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

PART 4 - EXECUTION

4.01 COMMISSIONING OF SYSTEMS AND EQUIPMENT

- A. Engage a factory-authorized service representative or technician who is familiar with this project to participate and assist, if necessary, in the functional performance testing of the equipment include in this Division with the Commissioning Agent.

4.02 INSTALLATION

- A. These Specifications do not enumerate all the details of fittings and accessory equipment required for proper operation of the systems herein described. It is understood that all necessary and required equipment shall be provided complete by the Contractor without extra compensation even though not specifically mentioned herein.

- B. The installation of the sound system and wiring shall be performed under the direct supervision of an authorized distributor of the sound system manufacturer.
- C. Provide labeling for each speaker cable termination onto the consolidation block. Label should indicate the speaker location and/or speaker array.
- D. The Integrator shall program the existing PA system to include all newly installed speakers and discrete sound systems.
- E. The installation, adjustment, testing and final connection of all conduit, wiring, boxes, cabinets, etc., shall conform to local electrical requirements and shall be sized and installed in accordance with manufacturer's approved shop drawings.
- F. Low-voltage wiring may be run exposed above ceiling areas where they are easily accessible.
- G. Contractor shall install new rack console at location shown on plans.
 - 1. Solder each speaker line splice and tape each individual wire.
 - 2. Connect remote slave clocks to master clock in console.
- H. All Administrative Phones shall be desk- or counter-mounted.
 - 1. Provide standard wall 120V AC receptacle 16" AFF
 - 2. Verify exact location with Architect
- I. Speaker and telephone lines run above ceiling and not in conduit shall be tie-wrapped to ceiling joist with a maximum spacing of 8' between supports. No wires shall be laid on top of ceiling tile.
- J. Connect field cable to each speaker transformer using UL butt splices for 22 AWG wire.
- K. Terminate field wiring on wall adjacent to rack using Telco 66 type blocks. Provide neat cross connect system for wiring. Wiring to be labeled to indicate final architectural room number that it services on the Telco block.
- L. Rack shall be labeled in numerical order with speaker/phone combinations first, speaker/outside horn combinations last. Labeling and order shall reflect final Architectural room numbers posted outside the rooms. Use three- (3), four- (4), five- (5), or six- (6) digit dialing extensions.
- M. Contractor shall provide a minimum of eight (8) hours of operational and programming instruction to school personnel.
- N. On the first school day following installation of Multicom System, the Contractor shall provide a technician to standby and assist in system operation.
- O. Mark and label all telephone outlets and/or sets with the graphic room numbers. Label all demarks IDF and MDF points with destination point numbers. Rooms with more than one outlet shall be marked XXX-1, XXX-2, XXX-3, etc. where XXX is the room number.
- P. No graphic room number shall exceed the sequence from 000001 through 899999.

Q. Mounting of devices

1. All speaker assemblies and other outlets shall be flush mounted, unless otherwise noted on drawings.

4.03 INSTALLATION OF CENTRAL CONTROL CABINET

A. The Central Control Rack may be assembled in a configuration consisting of one, two, or three cabinets bolted together. The Contractor shall install this rack where shown on the Drawings or where directed. This rack shall be bolted to the floor, or as directed, in an approved manner.

B. Cabinet Protection

1. The supplier of the central rack shall, at the time of delivery to the job site of the central control rack, provide the Contractor with canvas covers to protect this equipment during installation and connection. The canvas shall be of such weight as to withstand normal handling and to protect the metallic surfaces against abrasions and droplets of paint from soaking through. The cover shall extend to within 1" of the floor, and shall be so constructed to permit the lower 24" to be rolled up or otherwise raised allowing access to the terminal strips.
2. The covers shall be kept in place, except for necessary testing of the cabinet until all plastering, patching and painting in the vicinity is completed and in no event removed permanently until directed. The covers shall remain the property of the Contractor.

4.04 COORDINATION WITH INTEGRATED & CLASSROOM AUDIO VISUAL SYSTEMS

A. The Contractor shall coordinate all public address tie-lines for automatic shut off and classroom priority override with the AV Integrator.

4.05 LABELING

- A. Provide labeling for each speaker cable termination onto the consolidation block. Label should indicate the speaker location and/or speaker array.
- B. Provide a permanent label to identify each pushbutton, switch, control and outlet, etc. (tuner, cassette, CD, MP3, Mic.1, etc.). The label shall be mounted adjacent to the item it identifies. All labels shall be engraved or phenolic nameplates. Labeling using paper, glue or tape shall not be acceptable.

4.06 INSTALLATION OF SPEAKERS

- A. The Contractor shall install all sound systems as required by the Drawings and Specifications.
- B. All speakers shall be cabled with cable type and terminated back to the data rooms as indicated within the drawings.
- C. Speaker Settings:

1. All outside speakers shall be on a separate paging zone and time zone.
2. Speaker Tap settings:
 - 1) Offices (0.5) Watt
 - 2) Classrooms (1) Watt
 - 3) Corridor (2) Watts
 - 4) Cafeteria (2) Watts
 - 5) Outdoor (7.5) Watts
 - 6) Mech. Spaces (4) Watts

4.07 INSTALLATION OF SOUND SYSTEM WIRING

- A. All installations shall comply with NECA 1.
- B. Provide all conduits, conductors, boxes, receptacles, etc. indicated on the Drawings, herein specified, or required for the proper operation of the sound systems.
- C. Installation of all sound system wiring and all equipment shall be performed under the direct supervision of a C-EST certified Field Engineer.
- D. All Sound System conductors to and between the speakers and the Category 5E consolidation block shall be free from splices or other breaks.
 1. Interconnecting terminals as specified may be used only at terminals of loudspeakers, privacy switches, amplifiers, microphone receptacles, or where directed.
- E. All loudspeaker cables shall be terminated in the following manner:
 1. The end connected to the loudspeaker transformer leads shall be neatly soldered and taped where such loudspeakers are not equipped with terminal strips. Where loudspeakers are equipped with terminal strips, the ends shall be equipped with U-type solderless lugs described above.
 2. Where two or more loudspeakers are on the same circuit, shall be soldered neatly to terminals of the loudspeaker transformers to form a "loop" circuit.
 3. Unused leads or taps of loudspeaker matching transformers shall each be separately taped to insulate the conductors from each other and from grounded parts of the equipment.
- F. All connections between/among components within the Central Control Rack shall be performed under the direct supervision of personnel authorized by the manufacturer of the Central Control Rack.
- G. All connections of conductors entering the Central Control Rack and terminated at the terminal blocks shall be performed by the Contractor.
- H. All connections shall be made under the direct supervision of the Manufacturer's Representative. Connections shall not be made until the Contractor and the

Manufacturer's Representative have explained to the Owner's Representative the procedure to be followed.

- I. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- J. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- K. All cabling shall be plenum rated and properly gauged per the distances of the devices from the central control station.
- L. Grounding
 - 1. A dedicated # 10 ground wire shall be installed in conduit from the main ground bus of the electrical service and/or adequate building ground and attached to the frame of all the sound racks/cabinets and all required devices. Conduit bonds shall be used only for rack to rack continuities.

4.08 PROTECTION

- A. The contractor shall provide all necessary transient protection on the AC power feed and on all station lines leaving or entering the building.
- B. The contractor shall note in his system drawings, the type and location of these protection devices as well as all wiring information. Such devices are not to be installed above the ceiling.

4.09 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:

Upon completion of the installation, contractor shall engage a factory-authorized service representative to perform overall performance test in the presence of the Owner's representative. Provide testing reports and certificate of completion of testing. The test shall include, but not be limited to the following:

- 1. Loudspeaker Circuits Test
 - A. Transmit audio signals at normal levels over each loudspeaker circuit for determination of proper loudspeaker volume and clarity.
 - B. Adjust transformer taps for proper output, as necessary.
- 2. Input Circuits Test

- A. Transmit audio signals at normal levels over each input circuit to determine proper operation of each input circuit. The test shall be performed using each of the two input selector switches over each of the two program channels. Each input source (tuner, Mic., etc.) on the selector switch shall be tested.
3. Load Test
 - A. Check for proper system operation when the entire system load (all speakers) is applied to either channel.
4. Communications Tests
 - A. Initiate, by means of the central controls, two-way communications between classroom speaker and PA system.
 - B. ALL-CALL via Central Controls: Check all speakers in the entire new building, including all local sound system speakers.
 - C. Zone paging via central controls.
 - D. For all other local sound systems, test all microphone outlets and other input sources as shown on the Drawings.
 - E. Test the system of the hearing impaired for proper function and operation as described by the manufacturer.
5. Signal-to-Noise Ratio Test:
 - A. Measure signal-to-noise ratio of complete system at normal gain settings as follows:
 - 1) Disconnect microphone at connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at corresponding connectors with dummy loads, each equal in impedance to microphone it replaces. Measure signal-to-noise ratio.
 - 2) Repeat test for each separately controlled zone of loudspeakers.
 - 3) Minimum acceptance ratio is 50 dB.
6. Distortion Test:
 - A. Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.
7. Acoustic Coverage Test:

- A. Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
8. Power Output Test:
- A. Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.
9. Signal Ground Test:
- A. Measure and report ground resistance at public address equipment signal ground. Comply with testing requirements specified in Division 26 Section "Grounding and Bonding for Electrical Systems."
10. Inspection:
- A. Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.
11. Public address and mass notification systems will be considered defective if they do not pass tests and inspections.
12. Prepare test and inspection reports.
13. Include a record of final speaker-line matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.
- 4.10 SERVICE / MAINTENANCE / WARRANTY
- A. The contractor shall provide a five year equipment warranty of the installed system against defects in material and workmanship. All materials shall be provided at no expense to the owner during normal working hours. The warranty period shall begin on the date of acceptance by the owner/engineer.
 - B. The contractor shall, at the owner's request, make available a service contract offering continuing factory authorized service of this system after the initial warranty period.
 - C. The system manufacturer shall maintain engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.
 - D. The Contractor shall submit a written warranty from an authorized distributor of the sound system that the system installed is free from defects in materials and

workmanship, for the period of one year from the date of acceptance by the Owner.
This warranty shall include all parts and labor.

4.11 DEMONSTRATION – TRAINING

- A. Bidding contractor shall engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain video-surveillance system.
- B. The vendor shall provide various levels of training including Manufacturer provided training as mandated by the Owner
- C. Sixteen (16) hours of training shall be included as part of this specification. These training hours shall be partitioned as the Owner mandates and as required.

4.12 GENERAL FIELD POLICY

- A. When inspecting or supervising the installation of equipment, manufacturers' representative shall be accompanied at all times by the technology consultant. In order to make the necessary arrangements, the Owner shall be notified at least 48-hours in advance of the manufacturer's representative visit to the School.
- B. Any changes of equipment shall be made only with the written permission of the technology consultant.
- C. Changes in location of equipment may be made only with the written permission of the technology consultant.
- D. All changes of location of equipment (including pull boxes, conduit runs, wire sizes, etc.) shall be incorporated in the As-built Sound/System Intercom Riser Diagram installed in the School.

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SECTION 27 53 13

WIRELESS CLOCK SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Drawings:
 - 1. "T" Drawings – Technology Plans
- C. Related Sections:
 - 1. Division 27 51 16 Section "Public Address and Mass Notification System".

1.02 SCOPE OF WORK

- A. The Contractor shall provide a Wireless Clock System, including Global Positioning System (GPS) receiver, primary transmitter, satellite transmitter, analog clocks with batteries, conduit, wiring, etc., as shown on the Drawings and as indicated in the Specifications.

1.03 SUMMARY

- A. Section Includes:
 - 1. Master Clock
 - 2. Wireless Clocks
 - 3. Wireless transceivers
 - 4. Wireless repeaters
 - 5. Conductors and cables

1.04 SYSTEM DESCRIPTION

- A. The Wireless Clock System shall continually synchronize clocks throughout the facility, and shall be capable of clock readouts in multiple time zones where desired.
- B. The system shall synchronize all clocks to each other. The system shall utilize GPS technology to provide atomic time. The system shall not require hard wiring. Clocks shall automatically adjust for Daylight Savings Time.

- C. Analog Clocks shall be synchronized to within 10 milliseconds no less 6 times per day, and the system shall have an internal oscillator that maintains plus or minus one second per day between synchronizations, so that clock accuracy shall not exceed plus or minus 0.2 seconds.
- D. The system shall include an internal clock reference so that failure of the GPS signal shall not cause the clocks to fail in indicating time.
- E. The system shall incorporate a “fail-safe” design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.
- F. Clock locations shall be as indicated, and clocks shall be fully portable, capable of being relocated at any time.

1.05 REGULATORY REQUIREMENTS

- A. All equipment with digital Apparatus (microprocessors) that generate and utilizes timing signals at a rate in excess of 10,000 pulses per second to compute and operate, must be Federal Communications Commission (FCC) and “DOC” CSA Standards C108.8 (Electromagnetic Emissions) approved. Any equipment supplied or installed without the above approvals will not be accepted.
- B. Compliance with Government Regulations and Guidelines:
 - 1. FCC Class A: Compliant with FCC Part 15 Class A certification for minimal radiation in a classroom environment.
- C. Transmitter and receiver shall comply with Part 90 of FCC rules as follows:
 - 1. This device may not cause harmful interference.
 - 2. This device must accept interference received, including interference that may cause undesired operation.
 - 3. Transmitter frequency shall be governed by FCC Part 90.35.
 - 4. Transmitter output power shall be governed by FCC Part 90 257 (b)

1.06 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. In accordance with FCC regulations, an application for license must be filed prior to use of the equipment. The contractor shall submit a copy of the operating license to the Authority prior to installing the equipment. The original license shall be delivered to the school.
- C. Programming code and password for the system.

- D. Videotape of the personnel training.
- E. Test results and certificate of completion of testing.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain wireless clock system from single source.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Sapling is the approved manufacturer. This system will expand on an existing system in the building.

2.02 EQUIPMENT

- A. Wireless Clocks shall be SAPLING SAL series.
- B. The wireless clock system shall include a Master Clock, clocks, transmitters as required, a roof mounted GPS receiver, indicating clocks, and all accessories for complete operational clock system.
- C. The wireless clocks shall be battery operated and shall include all batteries.
- D. GPS Receiver: shall be a complete GPS receiver including antenna in a waterproof case, 3-7/8 inches by 4-3/16 inches by 2 inches, designed for roof or outdoor mounting. Provide mounting bracket for attachment to roof structure and required attached cable.
- E. Primary Transmitter: shall be a wireless transmitter with GPS receiver, a surge suppressor/battery backup, and a mounting shelf. Unit shall obtain current atomic time from satellite. The clock system shall transmit time continuously to all clocks in the system.
 - 1. Transmission:
 - a. Frequency Range: 72.100 to 72.400 MHz.
 - b. Transmission Range: one mile, open field.
 - c. Radio technology: narrowband FM

- d. Number of channels: 16
 - e. Channel bandwidth: 20 kHz maximum
 - f. Transition mode: one-way communication
 - g. Data rate: 2 KBps
 - h. Operating range: 0°C to 70°C
2. Transmitter:
 - a. Transmitter output power: +26 to +30 dBm
 - b. Frequency deviation: +/- 4 kHz
 - c. Transmitter power requirements: 120 VAC 60 Hz
 - d. Internal power requirements: 5 VDC
 - e. Carrier frequency stability: +/- 20 ppm
 3. Transmitter shall have 16 selectable channels to assure interference-free reception.
 4. Transmitter shall have the following switches:
 - a. Time zone adjustment switches for Eastern Time zone.
 - b. Daylight Saving Time bypass switch.
 - c. 12-hour or 24-hour display.
 5. Transmitter housing shall be black metal case, 16-3/4 inches by 12 inches by 1-7/8 inches in size.
 6. Antenna shall be 46 inches high, commercial type, mounted on top center of transmitter housing. Antenna gain shall be < 2.2 dB. Antenna polarization shall be vertical.
 7. Transmitter housing shall incorporate a display which shall include the following:
 - a. Time readout
 - b. AM and PM indicator if 12-hour time display is set
 - c. Day and date readout
 - d. Indicator for daylight savings or standard time
 - e. LED which shall flash red in event of reception problem

- f. GPS reception indicator
 8. Transmitter shall contain an internal clock such that failure of reception from the GPS shall not disable the operation of the clocks.
- F. Power supply
1. Input: 120 volt AC 50/60 Hz, 0.4 amps.
 2. Output: 9 volt DC, 1.5 amps.
- G. Surge Protector/Battery Backup
1. Input: 120 volt AC 60 Hz, +/- 1 Hz
 2. Output: 120 volt AC, 500 VA, 300 watts
 3. Surge Energy Rating: 365 joules
- H. Additional Equipment
1. Wireless Receiver Switches: Switches shall receive time packets from the Primary Transmitter and relay the synchronized time to the Satellite Transmitter (Repeater) connected to it. The unit shall include the following:
 - a. Antenna mounted on top of the switch housing, 11-1/2 inches long
 - b. Power Supply:
 - 1) Input 120 VAC 50/60 Hz, 0.4 amps
 - 2) Output: 9 volt DC, 1.5 amps
 - c. RS 232 data cable, 5 feet long
 - d. Daylight Savings Time bypass switch
 - e. Dimensions: 4-1/4 inches long, 5-3/4 inches wide, 1-1/4 inches deep
 - f. Weight: 12 ounces
 - g. Operating Range: 32°F to 158°F (0°-70°C)
 2. Satellite Transmitter (Repeater) shall receive the signal from the Wireless Receiver Switches and transmit the signal to the devices in its vicinity, which are out of the range from the Primary Transmitter.
 - a. Antenna mounted on top of the housing, 46 inches long
 - b. Wireless Receiver Switch
 - c. Power Supply

- 1) Input: 120 VAC, 50/60 Hz, 0.4 amps
 - 2) Output: 9 volt DC, 1.5 amps
 - d. 6 foot cord
 - e. Surge Suppressor/Battery Backup
 - f. Mounting Shelf
 - g. Approximately one Watt transmission
 - h. 72 MHz frequency
- I. Analog clocks with batteries: Analog clocks shall be wall mounted where shown on drawings and dual-side wall mounted on the corridors. Clocks shall have polycarbonate frame and polycarbonate lens. Face shall be white. Hour and minute hands shall be black. Analog clocks shall be provided with red sweep second hand and shall be 12" diameter.
1. Clocks shall be:
 - a. Classroom and other office areas - Sampling # SAL-2BS-12R series or equivalent.
 - b. Gymnasium - Sampling # SAL-2BS-16R series or equivalent.
 2. Analog clocks shall be battery-operated and shall have 5-year battery life normal mode and 8-year battery life in economy mode.
 3. Analog clocks shall be capable of a quick correction for Time-Change.
 4. Time shall be automatically updated from the transmitter 6 times per day.
 5. Analog clocks shall remember the time during changing of batteries.
 6. Analog clocks shall have a tamper proof/theft resistant clock lock mounting slots.
 7. Provide two D cells alkaline batteries per clock
 8. Analog clock receivers shall be as follows:
 - a. Receiver sensitivity: >-103 dBm
 - b. Receiver power: two alkaline D-cells
 - c. Antenna type: internal
 - d. Antenna gain: -7 dBd

9. If transmitter stops transmitting valid time signals due to power failure, the clocks shall continue to function as accurate quartz clocks until a valid time signal is decoded.

J. Master Clock

1. Sampling # SMA-2S0-1100-1 series or equivalent.

K. Wire Guards for Clocks

1. Provide wire guards for clocks in gymnasium and all spaces indicating a wire guard "WG" is required.

2.03 WIRING

- A. Provide duplex 3-wire grounded receptacle 20A, 125V next to the primary and satellite transmitter and connect to the emergency Panel.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The GPS Unit shall be installed on the roof in clear view of the sky. The GPS Unit shall be located on a suitable bracket, well above the level of standing or incidental water and above accumulations of leaves or debris. Cable connection to GPS shall be sealed with cable connection sealant. Any added cable lengths must be protected from outside elements.
- B. Transmitter:
 1. Locate transmitter where indicated, a minimum of 2 to 3 feet above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls.
 - a. The installation contractor shall assure optimum performance of the Wireless Clock System. The preferred transmitter location for best transmission coverage is required of the contractor of this section.
 - b. Quantity and placement of these transmitters shall be included as part of this installation.
 2. Contractor shall attach receiver to transmitter using cable and connect antenna to transmitter, using care not to strip threads.
 3. Set the channel number on the display to correspond to the FCC license.
- C. Analog clocks with batteries: Contractor shall perform the following operations with each clock:

1. Install batteries and set clock to correct time in accordance with manufacturer's instructions and verify that valid signals are received, and analog clock adjusts itself to correct time.
 2. Install the analog clock on the wall in the indicated location, plumb, level and tight against the wall. Attach using clock-lock hanging method and suitable fasteners as approved by clock manufacturer.
- D. Wire guards: Secure to wall, using approved theft-resistant fasteners.
- E. Prior to final acceptance, clean exposed surfaces of clocks, using cleaning methods recommended by clock manufacturer. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.
- F. All wiring shall be in raceway and shall conform to the requirements of the equipment manufacturers and the Specifications.
- G. Upon completion of the installation and prior to system acceptance, the system shall be tested under the supervision of the manufacturer's representative and in the presence of the Owner's Representative. Any and all defects and deficiencies shall be corrected to the Owner's approval at no additional cost.
- H. The test shall include a power failure simulation to test reset operation.
- 3.02 GROUNDING
- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- 3.03 FIELD QUALITY CONTROL
- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
Upon completion of the installation, contractor shall engage a factory-authorized service representative to perform overall performance test in the presence of the Owners representative. Provide testing reports and certificate of completion of testing.
- 3.04 WARRANTY
- A. The Contractor shall submit a certificate from an authorized distributor of the wireless clock system, certifying that the installation of the entire system is in conformance with the requirement of the manufacturer.
- B. The Contractor shall submit a written warranty from an authorized distributor of the wireless clock system that the system installed is free from defects in materials and workmanship, for the period of one year from the date of acceptance by the Owner. This warranty shall include all parts and labor.

3.05 INSTRUCTION OF PERSONNEL

- A. The Contractor shall arrange with the authorized distributor of the wireless clock system, to instruct persons designated by the Owner in the proper operation and care of the wireless clock system. A minimum of two (1) 2-hour training periods shall be provided.
- B. The instruction shall include operating of the entire system.
- C. The Contractor shall arrange with the manufacturers of the equipment to instruct the BOE Custodian or building manager in the proper operation and care of the Wireless Clock System equipment. Provide Operation and Maintenance Manuals.
- D. Training of BOE Custodian or building manager shall be videotaped by the trainer (or contractor). A minimum of two (2) 1-hour training periods shall be provided. Tapes shall be labeled and turned over to the Authority's Representative within forty-eight (48) hours of training completion.
- E. Deliver to the Authority three (2) sets of operating instructions and programming manual for the clock system.
- F. Programming code and password for the system.

3.06 GENERAL FIELD POLICY

- A. When inspecting or supervising the installation of equipment, manufacturers' representative shall be accompanied at all times by the Owner's Representative. In order to make the necessary arrangements, the Owner's Representative shall be notified at least 48-hours in advance of the manufacturer's representative visit to the School.
- B. Any changes of equipment shall be made only with the written permission of the Owner's Representative.
- C. Changes in location of equipment may be made only with the written permission of the Owner's Representative.

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SECTION 28 05 00

SECURITY CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Drawings
 - 1. "T" Drawings – Technology Plans
- C. Related Sections:
 - 1. Division 281300 Section "Access Control" devices.

1.02 SUMMARY

- A. Description
 - 1. The awarded installation contractor of this section shall furnish and install all the cabling indicated within the architectural drawings associated with the Intrusion detection system and all access control devices associated with the secured doors. The access control devices shall be specified during the renovation phase of the High School.
- B. Section Includes:
 - 1. Pathways.
 - 2. Security cabling.
 - 3. Cable connecting hardware.
 - 4. Cabling system identification products.
 - 5. Electronic safety and security equipment coordination and installation.
 - 6. Common electronic safety and security installation requirements.

1.03 DEFINITIONS

- A. "Project Manager" shall mean the Owner's appointed representative.

- B. "As Necessary" shall mean work, which is required for completed construction, but is not necessarily shown or described in the Contract Documents.
- C. "As Required" shall mean work which is required for completed construction and is shown on the drawings or described in the project specification.
- D. "Install" shall mean to set in place complete with all mounting facilities and connections as required ready for normal use of services.
- E. "Substantial Completion" shall mean that the project is sufficiently complete to be utilized for its intended use as stated in the body of this written specification.
- F. "Conduit" shall include all fittings, sleeves, connections, hangers and other accessories related to such conduit.
- G. "Surface Metal Raceway" shall include all fittings, sleeves, connections, hangers and other accessories related to such raceway.
- H. "Concealed" shall mean hidden from sight, as in chases, furred spaces, shafts, fixed ceiling or embedded in construction.
- I. "Exposed", shall mean not "concealed" as defined above.
- J. "Governmental" shall mean all municipal, state and federal government agencies.
- K. The words "Furnish", "Supply" and "Provide" shall mean purchase, deliver to the job site, protect and provide interim storage and install in accordance with manufacturer's specifications.
- L. Words "Approved Equal" shall mean any product which in the opinion of the Technology Consultant is equal in quality, arrangement, appearance, and performance to the product specified.
- M. "Cabling" shall mean cable assembly, raceway, conductors, fittings and any other necessary accessories to make a complete wiring system.
- N. "Product" shall mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.
- O. Words in the singular shall also mean and include the plural, wherever the context so indicates, and words in the plural shall mean the singular, wherever the context so indicates.
- P. "Contractor" refers to the bidding/installation Contractor responsible for furnishing and installation of all work indicated within this specification.

1.04 SECURITY CABLING DESCRIPTION

- A. Security cable and its connecting hardware provide the means of transporting signals between the remote security devices and the main hardware located within the communications equipment rooms.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated and utilized.
- B. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. All materials and workmanship shall comply with the latest additions of all applicable Codes, Specifications, Local and State Ordinances and Industry Standards.
 - 2. The Contractor shall promptly notify the Construction Manager in case of conflict between Building Codes, State Laws, Local Ordinances and the Contract Documents.
 - 3. Should the Contractor perform any work that does not comply with the requirements of the applicable Building Codes, Local Ordinances and Industry Standards, they shall bear all costs arising in correcting the deficiencies.
 - 4. The Contractor, for the work in their scope, shall give all necessary notices, obtain all permits, pay all governmental taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. The Contractor shall obtain all required Certificates of Inspection for his respective work and deliver same to the Construction Manager before request for acceptance of their work is made and before final payment.

1.07 COORDINATION

- A. Coordinate layout and installation of security pathways and cabling with Owner's telecommunications and LAN equipment and Security service suppliers.
- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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Security Conductors and Cables

1. Belden CDT Inc. Electronics Division.
 2. West Penn.
 3. Approved Equivalent.
- B. Cabling size and conductor quantities are described within the architectural drawing package.

2.02 SLEEVE SEALS

- A. Sleeves shall be adequately sized for the conduits and cables to be installed, with sufficient free space to install sealing caulk or putty. All sleeves will be fabricated of 1" minimum O.D. EMT, de-burred, material with a plastic or metal collar securely fastened to each end.
- B. Where penetrations are within floor slabs and fire rated partitions, pack the annular space between the sleeves and the conduit or cables with fire-retardant putty. The sealant material shall be intumescent, asbestos free and installed in accordance with UL and the manufacturer's instructions.
- C. Fire-retardant sealer and system shall be UL listed for the application and meet ASTM E-84, ASTM E-814, and UL 1479 requirements. Use Nelson "FSP" or approved equal.
- D. If Contractor elects to utilize any penetration which may currently exist, then it is the Contractor's responsibility to properly sleeve and firestop that penetration prior to completion of project.

2.03 FIRESTOPPING

- A. All conduits etc., passing through fire rated floors, walls and partitions, shall have the space between the raceways, sleeves and all penetrations filled with a reusable fire stopping material such as Firestop Putty, Adhesive Firestop Sealant or Firestop Compound as manufactured by STI or approved equal.

2.04 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. All security cabling shall be labeled at both ends.

2.05 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Testing: Continuity of cabling shall be performed, and test results submitted to the Owner.

PART 3 - EXECUTION

- 3.01 All locations shown on the architectural drawings are for approximation purposes only and must be field verified prior to installation. 10' service loops are required to enable terminations subsequent to device installation.

****End of Section****

SECTION 28 05 28

PATHWAYS FOR SECURITY SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Drawings
 - 1. "T" Drawings – Technology Plans

1.02 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Optical-fiber-cable pathways and fittings.
 - 4. Metal wireways and auxiliary gutters.
 - 5. Nonmetallic wireways and auxiliary gutters.
 - 6. Surface pathways.
 - 7. Boxes, enclosures, and cabinets.
 - 8. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:
 - 1. Section 260533 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.
 - 2. Section 270528 "Pathways for communication systems" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.03 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, equipment racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.

3. Alpha Wire Company.
 4. Anamet Electrical, Inc.
 5. Electri-Flex Company.
 6. O-Z/Gedney; a brand of EGS Electrical Group.
 7. Picoma Industries; Subsidiary of Mueller Water Products, Inc.
 8. Republic Conduit.
 9. Robroy Industries.
 10. Southwire Company.
 11. Thomas & Betts Corporation.
 12. Western Tube and Conduit Corporation.
 13. Wheatland Tube Company; a division of John Maneely Company.
- B. General Requirements for Metal Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew.
 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 3. Anamet Electrical, Inc.
 4. Arnco Corporation.
 5. CANTEX Inc.
 6. CertainTeed Corp.
 7. Condux International, Inc.
 8. Electri-Flex Company.
 9. Kraloy.
 10. Lamson & Sessions; Carlon Electrical Products.
 11. Niedax-Kleinhuis USA, Inc.
 12. RACO; a Hubbell company.
 13. Thomas & Betts Corporation.
- B. General Requirements for Nonmetallic Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.
- C. RNC: Type EPC-40-PVC complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Rigid HDPE: Comply with UL 651A.
- E. Continuous HDPE: Comply with UL 651B.
- F. RTRC: Comply with UL 1684A and NEMA TC 14.
- G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- I. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.03 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alpha Wire Company.
2. Arco Corporation.
3. Endot Industries Inc.
4. IPEX.
5. Lamson & Sessions; Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible-type pathway, approved for plenum installation unless otherwise indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

2.04 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hoffman; a Pentair company.
3. Mono-Systems, Inc.
4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250 and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.05 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allied Moulded Products, Inc.
2. Hoffman; a Pentair company.
3. Lamson & Sessions; Carlon Electrical Products.
4. Niedax-Kleinhuis USA, Inc.

B. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.06 SURFACE PATHWAYS

- A. General Requirements for Surface Pathways:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.
- B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mono-Systems, Inc.
 - b. Niedax-Kleinhuis USA, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.
- C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems Division.
 - b. Lamson & Sessions; Carlon Electrical Products.
 - c. Mono-Systems, Inc.
 - d. Panduit Corp.
 - e. Wiremold / Legrand.

2.07 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. Hoffman; a Pentair company.
6. Hubbell Incorporated; Killark Division.
7. Lamson & Sessions; Carlon Electrical Products.
8. Milbank Manufacturing Co.
9. Molex; Woodhead Brand.
10. Mono-Systems, Inc.
11. O-Z/Gedney; a brand of EGS Electrical Group.
12. RACO; a Hubbell company.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.

- B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-B.
2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.

- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

- F. Metal Floor Boxes:

1. Material: Cast metal

2. Type: Fully adjustable.
 3. Shape: Rectangular.
 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.
1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Device Box Dimensions: as specified within the architectural drawings.
- K. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures:
 - a. Material: Plastic.
 - b. Finished inside with radio-frequency-resistant paint.
 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

PART 3 - EXECUTION

3.01 PATHWAY APPLICATION

- A. Indoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Damp or Wet Locations: GRC.
 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
 7. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: Plenum-type, optical-fiber-cable pathway.
 8. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- B. Minimum Pathway Size: 3/4-inch trade size. Minimum size for optical-fiber cables is 1 inch.
- C. Pathway Fittings: Compatible with pathways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use setscrew or compression, cast-metal fittings. Comply with NEMA FB 2.10.
- D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- E. Install surface pathways only where indicated on Drawings.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg.

3.02 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Pathways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from ENT to RNC, Type EPC-40-PVC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- R. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 2. Install surface pathway with a minimum 2-inch radius control at bend points.
 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
 2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
 3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
- U. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service pathway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- W. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.

- c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
 - X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
 - Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
 - Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
 - AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
 - BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
 - CC. Set metal floor boxes level and flush with finished floor surface.
 - DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- 3.03 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."
- 3.04 FIRESTOPPING
- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.05 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

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SECTION 28 13 00

ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to the following construction documents for Data Room locations and device locations only.
 - 1. "T" Drawings – Technology Plans

1.02 Section Includes

- A. Intercom/Door release with Video: Aiphone
- B. Access Control System (ACS)

1.03 SUMMARY

- A. Section includes a video-intercom-door-release unit with associated installation and configuration of the equipment.
- B. The awarded contractor of this section shall furnish and all required devices into this facility.
- C. All installation, peripheral devices, required licensing and configurations are required as part of this specification to establish a coherent, functional system as described within this bid package.
- D. Security control and network cabling to/from the equipment rooms to the controlled doors, as described within the documents shall be furnished and installed by the contractor awarded this section.
- E. Any and all additional interconnection cabling required for a functional system shall be furnished and installed by the contractor awarded this section.
- F. Final terminations to all devices are required by the bidding integrator of this portion of work.
- G. The electric strikes and power devices for these strikes are furnished and installed by other sections; only the connectivity and configuration of these devices to a "fail-secure" state is required by the awarded contractor of this section.

- H. The Integrator awarded this portion of work shall provide and install a complete integrated security system and all associated, terminations, supporting devices, configuration of system, testing and training in accordance with this Bid package.
- I. This system shall be integrated with the building's fire alarm system as required for proper activation of "fail-secure" locking mechanisms.
- J. All interconnections required to the fire alarm system shall be terminated by the fire alarm installers and shall be coordinated with the contractor awarded this portion of work.

1.04 DEFINITIONS

- A. IP: Internet protocol.
- B. LAN: Local area network.
- C. WAN: Wide area network.
- D. AS NECESSARY: Shall mean work which is required for completed construction, but is not necessarily shown or described in the Contract Documents.
- E. AS REQUIRED: Shall mean work which is required for completed construction, but is not necessarily shown or described in the Contract Documents.
- F. SUBSTANTIAL COMPLETION: Shall mean that the project is sufficiently complete to be utilized for its intended use as stated in the body of this written specification.
- G. CONTRACTOR/INTEGRATOR: Refers to the bidding/installation Contractor responsible for furnishing and installation of all work indicated within this specification.

1.05 PERFORMANCE REQUIREMENTS

- A. Environmental Conditions – System(s) shall withstand the environmental conditions without mechanical or electrical failure, damage or degradation of its operating capacity.

1.06 SUBMITTALS

- A. Product Data: Submit manufacturer's product specification sheets for every product to be used in this system within two (2) weeks of award of project. Product specification sheets must have the product being utilized and its part or model number visibly indicated. Product data shall include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.
- B. Equipment and System Operation Description – Include the method of operation and supervision of each component and type of circuit. Show the sequence of operation for manually and automatically initiated system(s) or equipment inputs. Description must cover this specific project.

- C. Operation and Maintenance Data – For the intrusion/detection access control system, shall include the emergency, operation and maintenance manuals and shall include the Central-Station control unit hardware and software data.
- D. Include an itemized bill of materials and a detailed description of the proposed system(s) within the bid response. Any appendices are only intended to assist the contractor to formulate a bid. Quantities are estimated and should be verified by contractor.
- E. Shop Drawings: For access control system shall be provided within two (2) weeks of system substantial completion acceptance. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes utilized.
- F. In the event that the installation contractor does not furnish or does not supply sufficient documentation, the owner has the right to engage a separate contractor to attain any or all required documentation. All costs related with this event shall result in a back charge to the installation vendor via a change order.
- G. Warranty: Sample of special warranty.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications – Installer must be a certified, factory trained, accredited and licensed installer for the manufacturers described within this specification.
- B. Installer Qualifications – A qualified manufacturer shall maintain a service center capable to provide training, parts and emergency maintenance repairs for the overall systems described within this Security specification and drawings. This response time must not exceed twelve (12) hour period.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NECA 1.
- E. Comply with NFPA 70.

1.08 PROJECT CONDITIONS

- A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Interior, Controlled Environment: System components installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and twenty to ninety percent (20-90%) relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.
2. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and twenty to ninety percent (20-90%) relative humidity, noncondensing. Use NEMA 250, Type 3R enclosures.
3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and twenty to ninety percent (20-90%) relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 24 inches thick. Use sufficiently rated NEMA 250 enclosures.
4. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.
5. Corrosive Environment: System components subject to corrosive fumes, vapors, and wind-driven salt spray in coastal zones. Use sufficiently rated NEMA 250 enclosures.
6. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.09 WARRANTY

- A. The Integrator guarantees the Systems to be installed under this specification to be free from any defects in workmanship and materials for a period of one (1) year from the date of final completion/acceptance of the project by the Owner as evidenced by the date of final payment for the work. The Contractor shall promptly and at their own expense remedy any defects in the work and pay for any damage to other work resulting thereof, which shall appear during the period of time covered by this guarantee. Neither the final certificate of payment nor any provisions in this Agreement shall constitute an acceptance of work not done in accordance with this specification or relieve the Contractor of liability with respect to any expressed warranties or guarantees or responsibility for faulty materials or workmanship.
- B. The Integrator shall provide all services required to maintain the system in an operational state as specified by the manufacturer for a period of one (1) year after acceptance.
- C. Service response shall be within twenty-four (24) hours of the initial request for service and shall be provided twenty-four (24) hours per day, seven (7) days per week and three hundred sixty-five (365) days per year.

- D. The Contractor shall provide software and firmware upgrades as required and available to the Owner.
- E. Submit manufacturer's standard warranties.

PART 2 - PRODUCTS

2.01 INTERCOM-VIDEO-DOOR-RELEASE STATIONS

- a. The selected manufacturer shall be AIPHONE CORPORATION, Bellevue WA – USA. Other manufacturers will be considered, providing equipment meets or exceeds the quality and functionality specified.
- b. The selected system shall be an IP based system sending audio and video over category rated cabling that has already been installed by others.
- c. The selected model shall be:
 - 1) AIPHONE Series #IS as indicated on drawings.
- d. All interconnecting cabling is required as part of this bid.

2.02 ACCESS CONTROL (ACS)

- A. All ACS head-end equipment, including field multiplex panels, input/output control boards, and any other equipment needed to make a fully functional, networked access control system shall be manufactured by AMAG, or approved equal selected and approved by Owner.
- B. Due to the rapid changes in computer hardware and software development, the contractor shall provide at time of installation the most current version of computer hardware and operating system software. The contractor shall carry in his price all monies and fees to upgrade software and hardware to meet the current technology at the time of the installation
- C. The Access Control System shall be compatible with Stamford Police Department's access control system (AMAG). Stamford Police Department (SPD) shall have the ability to monitor and control the Stamford IB School access control system utilizing a connection to their existing ACS platform.
- D. ACS Equipment
 - 1. Intelligent System Controller (ISC)
 - a. Intelligent System Controllers (ISC's) shall be as manufactured by AMAG, model M2150, or approved equal selected and approved by Owner.
 - b. ISC enclosures shall include tamper switch. Tamper switch shall be wired to ACS system as an alarm input.
 - c. ISC shall be powered via an external, 12/24 VDC power supply.

2. Reader Interface Module (RIM)
 - a. Reader Interface Modules (RIM's) shall be as manufactured by AMAG, or approved equal selected and approved by Owner.
 - b. RIM enclosures shall include tamper switch. Tamper switch shall be wired to SMAC system as an alarm input.
 - c. RIM's shall be powered via an external, 12 VDC power supply.
 - d. RIM's shall be provided with 12V battery kit.
3. Input Control Module (ICM)
 - a. Input Control Modules (ICM's) shall be as manufactured by AMAG, or approved equal selected and approved by Owner.
 - b. ICM enclosures shall include tamper switch. Tamper switch shall be wired to SMAC system as an alarm input.
 - c. ICM's shall be powered via an external, 12VDC power supply.
 - d. ICM's shall be provided with integrated battery kit.
4. Output Control Module (OCM)
 - a. Output control Modules (OCM's) shall be as manufactured by AMAG, or approved equal selected and approved by Owner.
 - b. OCM enclosures shall include tamper switch. Tamper switch shall be wired to SMAC system as an alarm input.
 - c. OCM's shall be powered via an external, 12VDC power supply.
 - d. OCM's shall be provided with integrated battery kit.
5. Intrusion Detection System Panel integration
 - a. Contractor shall program AMAG system interoperability with the existing Sonitrol Intrusion Detection System. Minimally, this programming shall allow an operator to arm/disarm intrusion zones from within the Access control system.
 - b. Provide input and output modules to accommodate all alarm point wiring as shown on the security contract drawings, plus an additional ten percent (10%) spare capacity for future expansion.
6. Card Readers
 - a. Card readers shall be as manufactured by HID, iCLASS-SE model RK40 wall mount proximity reader with keypad. Coordinate mounting details with Architect.
7. Access Control Credentials
 - a. Provide 1000 iCLASS Comp cards. Coordinate access cards with Owner's existing card format. Cards are to be ordered in sequential order and shall not overlap with existing access card numbering.
8. Security Workstations
 - a. ONE security workstation shall be provided for the ACS and shall meet the following specifications as a minimum:
 - b. Windows 8 Professional operating system. Contractor shall verify compatibility with ACS system prior to purchase and adjust Windows operating system purchase as necessary
 - c. 4th Generation i7 Intel processor, 3.40 GHz or greater
 - d. 500 GB on C: partition
 - e. 8 GB of DDR3 SDRAM
 - f. 10/100/1000 Base-T network interface card

- g. 256 MB video card with dual DVI output
 - h. Internal CD/DVD burner drive
 - i. Enterprise version of Anti-virus software and Anti-spyware software to support all servers and workstations inclusive of all VMS workstations
 - j. Each workstation shall be provided with a minimum of 2 x 22" LED monitor, as manufactured by Viewsonic or approved equal, as well as keyboard and mouse.
 - k. Each security workstation shall be equipped with client licenses of AMAG ACS software.
9. All system controller panels, door controller panels, input module panels, and output module panels shall be installed in locked cabinets, fixed with tamper switches which are subsequently tied into the alarm point monitoring system
10. Power supplies for all access control head-end equipment, including field multiplex panels, input/output control boards, and card reader control boards shall be as provided by manufacturer. Power supply shall be wire-in type, and shall be enclosed in factory enclosure. Provide tamper switch on factory enclosure door and wire to alarm monitoring system as an alarm input

PART 3 - EXECUTION

3.01 EXAMINATION

A. Device Locations

1. All device locations are to be field verified with the Owner prior to start of project. Architectural drawings are for approximation purposes only. Additional charges will not be allowed for outlet installation in areas not reviewed or approved by the Owner.

B. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 WIRING

A. Control and low-voltage s has been provided and installed by others and is referenced within the Drawings. This cabling has been roughed in and is within the junction boxes adjacent to each door requiring access controls. Final terminations to all devices are required by the bidding integrator of this section.

B. Final connections at both the device end and data closet and including any additional cable necessary for these connections is required as part of this bid.

- C. Access Control System Card Reader Data and Power Cable shall be 7 conductor, #18 AWG UL listed, stranded with overall shield and drain wire, WPW, #3281. Note 7 conductor cable is minimum, even if reader requires less than 7 conductors.

3.03 INSTALLATION

- A. The integrator awarded this section shall be responsible for full configuration of the Access Control System in accordance with the clients requirements and operations. The integrator shall meet with the client three (3) weeks before deployment in order to coordinate these requirements and operations.
- B. ACS Equipment
 1. Install PC's, monitors and printer's, at Security Control Centers per detail on Security Drawings. Coordinate equipment location with other security equipment layout, and mounting details. Install to maximize hands-on use and provide maximum maintenance capability. Review maintenance criteria with system manufacturer and site installation requirements to assure proper dimensional clearances, environmental conditions, and user operational capabilities.
 2. Mount ACS Server in the separate designated vertical racks located in the Security Equipment Room.
 3. Hook-up to 120VAC power fed from UPS circuits via power outlet strips to provide system with power via line conditioner/UPS.
 4. Connect card readers / bio-metric readers, electric door locks, door contacts, and lock power supplies to card reader interface to provide local door access control interface and program system database accordingly.
 5. Connect all remote ACS panels to dedicated 120 VAC emergency circuits provided in Data Rooms shown on the security and electrical drawings.
 6. Mount printers in Security Control Room with paper take-up and discharge platform and connect to UPS power outlets.
 7. Load all operating and applications software and fully test all system functional modules and features, assist the Owner in the creation of and load the Owner-provided database information, and create complete, fully operational card access user files for all system alarm points as directed by the Owner or his designee.
 8. Insure system is factory tested prior to shipment to site. Test shall verify function of PC, software, loop controller and typical field panels, one of each type. Provide factory test report to the Engineer prior to installation of equipment on site.
 9. Create Graphical User Interface (GUI) that contains map of the facility with security device overlays. Security device overlays shall indicate current status (alarm, normal, etc.).
 10. Output Relay Control (RC)
 - a. Connect to data communication network per manufacturer's instructions.
 - b. Program PC to command relays to change state in response to "door forced open" alarms, and other card access exceptional conditions, and card access system related security zone exceptional condition inputs as

- required for ACS system interface as directed by the Engineer and these Specifications.
- c. Connect to 120VAC emergency circuits and test unit for “loss of AC / on battery” operation.
 - d. Connect tamper switch to alarm monitoring panel as an alarm input, utilizing required end-of-line resistors for circuit supervision.
11. Card Reader Interface (CI)
- a. Connect to data communications network wiring per manufacturer’s instructions, in conduit.
 - b. Connect to card reader, door contacts, request to exit device(s) electric lock(s), and electric lock power supply per manufacturer’s instructions, in conduit.
 - c. Connect to supplemental power supply with battery back-up to power CI, and connect this supplemental power supply to 120VAC emergency circuit.
 - d. Connect enclosure tamper switch to alarm monitoring panel as alarm input, utilizing required end-of-line resistors for circuit supervision.
 - e. Connect to relay output which shall unlock lock and shunt door alarm contact.
 - f. Program to achieve specified functions.
 - g. Connect to request to exit devices, which, for electric strike and/or electric panic bars or mortised lock equipped doors, shall shunt door alarm contact only. It shall not unlock lock.
12. ACS Panels
- a. Connect to data communications network per manufacturer’s instructions.
 - b. Connect to 120 VAC emergency circuit.
 - c. Program to achieve specified functions.
 - d. Connect tamper switch to alarm monitoring panel as an alarm input, utilizing required end-of-line resistors.
 - e. Connect to card reader, door contacts, REX devices, electric lock power supply per manufacturer’s instructions.
 - f. Provide loss of AC power and low battery as security zone inputs using relay interface or internal software features.
 - g. Coordinate interface to fire alarm system, where required, to ensure that locks identified to be unlocked during a building fire alarm condition are denied power to crate unlocked condition. Furnish and install all conduit and wiring between ACP and fire alarm relays, and lock power supplies as required. Fire alarm “power kill” relays to be wired at Data Room by Electrical Contractor.
13. Additional 120 VAC Surge Suppression
- a. Provide additional 120VAC feed surge suppression for all devices which comprise the ACS network, (additional to that provided by the system manufacturer), to protect equipment from utility transient and lightning induced strikes, conducted through the 120 VAC emergency feeds connected to this equipment. 120 VAC surge suppression shall be as manufactured by PolyPhaser, or approved equal. Include all necessary ground wiring as required by surge suppression manufacturer’s installation instructions.

14. Factory Support

- a. A full service contract, providing all parts and field labor on equipment shall be available, local (90 miles) to the site with labor to be provided by factory trained, system technicians. Manufacturer shall have available an existing, regularly scheduled formal factory training program for Owner's technicians.
- b. The successful Bidder shall engage the services of the local Factory Customer Service Technician to perform or supervise the final hook-up, integration and check-out of the System, and to insure validation of the Warranty of system components at the site.
- c. The Contractor shall include in his Bid Cost, one complete factory training session, as required to support the Owner's system users in system's operation, database creation, and all other aspects of intended user interface.

C. Card Reader

1. Install onto finished walls adjacent to door to be controlled, using concealed bolts as required by wall construction and manufacturer's instruction. Surface mount reader in all locations.
2. Coordinate final placement and mounting of unit to assure placement is compatible with conduit and cable runs, device operation, and ADA requirements. Refer to Architect's interior elevations for exact placement requirements.
3. Install stainless steel or cast aluminum weather shroud on all exterior readers. Maintain 8" clear between shroud and proximity type readers, so as not to affect read range. Seal all exterior units with 50 year silicone and neoprene gaskets to eliminate water and/or moisture ingress.
4. Wire electric lock "energize" circuit through card reader interface (CI) output relay to achieve activation of lock. Install diode suppression utilizing diodes of factory recommended rating to protect card reader interface electronics from back EMF from lock.
5. Set energize relay adjustable timer between 5 and 10 seconds to allow adequate time for passage through from access side location. Confer with Owner's representative and program time accordingly to allow passage but discourage tailgating.
 - a. Allow valid door exiting and assure detection of forced entry, by use of "request-to-exit" motion detector(s) or built-in REX switch in lock, and programming of alarm shunt functions. REX to shunt contact only, not unlock lock. Review REX shunt timing with Owner's representative and program time accordingly to allow exiting but enforce "door forced" alarms.
 - b. Wire card readers to dedicated CI, using cable per manufacturer's recommendations with shield, and terminate shield on dedicated RF ground in CI enclosure, separate from 120VAC grounding.
 - c. Label reader with door number and name for use by visitors and staff to assist in identification of where they will be granted access. Review nomenclature with Owner's representative prior to labeling to gain approval

of agreed language. Use professional labeling decals such as those produced by “Kroy” or “Brother” label machines.

- d. Review reader mounting with Construction Manager and manufacturer’s instructions, paying special attention to related, adjacent construction material constraints. Review prior to reader rough-in to ensure compliance with manufacturer’s recommended mounting details and adequate physical blocking to insure strong and secure attachment.
- e. Use plastic back boxes when proximity readers are used.
- f. Insure extra cable coils are not left in reader back box when proximity boxes are used.
- g. Refer to Installation Detail for specific configuration and special conditions.

D. 12/24 VDC Security Device Low Voltage Power Supplies

- 1. Install in locations shown on Drawings in Data Rooms adjacent to ACS panel, ACS remote input module enclosures, etc and connect to security devices per floor plan notes and riser details, manufacturer recommendations and device installation specifications.
- 2. Hard wire into 120VAC source provided by Electrical Contractor. Wire loss of “AC” power relay and low battery relay in panel enclosure, and connect as separate alarm zones to intrusion detection input utilizing end-of-line resistors.
- 3. Wire from 12VDC individually fused terminals to 12VDC security device power circuits. Do not exceed 200 milliamps of connected load to any one fused circuit without the approval of the engineer. Do not exceed 90% of overall power supply power output rating.
- 4. Check to assure charging circuits and power supply module is operating, producing proper “on-battery” current, proper output voltage at load, and does not exceed advertised ripple, and that power supervision relays change state. Battery back-up shall be 8 hour minimum at full load. Calculate number of 12 VDC powered devices per 12 VDC circuit, and number of circuits per power supply. Assume all devices in normal state (largest current draw), and systems back up time capability present under this heaviest device load condition. Provide additional batteries in separate, externally protected, enclosure as required.
- 5. Mount to provide 3'-0" clear in front of enclosure doors, and provide tamper switch on doors wired to intrusion detection panel as tamper switch zone via end-of-line resistors.
- 6. Tag all 12VDC circuits with panel and 12VDC circuit number at both devices and at power supply fuse strip.
- 7. Wire out to 12 VDC devices using twisted, shielded, unique color-coded cable per specifications.
- 8. Wire 12VDC duress circuits through separate local to ACS panel, “reset” buttons to kill power to latching LED’s and therefore provide remote reset function from each 12 VDC power supply at the Data Room location.
 - a. Unit shall be UL listed, and come complete in enclosure with batteries, lock, tamper switch, loss of AC relay, low battery monitoring, fused output circuits, etc.

3.04 PROGRAMMING

- A. The Security Contractor shall be responsible for programming / configuring the entire security system and all subsystems to provide complete operation and monitoring as specified herein and/or as clarified by the Owner. The Security Contractor shall provide an initial programming setup in accordance with the Security Specifications. The Owner shall provide a written list to the Security Contractor with the desired system and subsystem programming modifications, additions, deletions, etc.
- B. The Security Contractor shall request programming information relating to response instructions, zone numbers, and any/all special programming information. The request shall be in writing to the Owner's representative four weeks prior to commencement of programming the system. In the letter, the Security Contractor shall provide descriptive information of the available options and what can be reported by the system for each device, and identify all required questions which the Owner must respond to in order to complete system's programming.
- C. The Security Contractor shall request programming information relating to response instructions, zone numbers, and any/all special programming information. The request shall be in writing to the Owner's representative, six months prior to commencement of programming the system. In the letter, the Security Contractor shall provide descriptive information of what is to be reported by the system for each device, and identify all required questions which the Owner must respond to in order to complete system's programming.
- D. The Security Contractor shall load the Project database for the Owner, as called out above. System testing shall include coordination and complete testing of each of the individual security system's operating programs and their interface with one another. The Security Contractor shall provide all the necessary database loading forms and informational requirements, a database loading/ creation manual, and five (5) four (4)-hour sessions to work with the Owner in database information development and use of manuals and forms. This is in addition to the training requirements.
- E. The Security Contractor shall provide a hard copy back-up database and two electronic copies for all systems and subsystems, including but not limited to access control system badging, and emergency communication subsystems.
- F. The Security Contractor shall provide complete interface and integration programming between the systems and subsystems, and this shall include, but not be limited to:
- G. Access Control System
 - 1. End user defined fields, as allowed by the access control system software package for each alarm input, time zone, character fields, data fields, clearance fields, facility codes, expiration dates, names, user codes, etc.
 - 2. Obtaining AutoCAD security floor plans and modifying/simplifying and providing interactive security device templates through a map loaded program (Only if not accomplished through video surveillance system. If accomplished through video surveillance system, complete interface with video surveillance system and maps/GUI and all other subsystems).

3. Obtaining all database information from Owner and providing detailed assistance to the Owner for database creation, revisions, and all other applicable options.
4. Obtaining specific instructions for each alarm or passive event from the Owner and input into system at all appropriate locations. Provide up to 3 instruction sets for each event. (Daytime, nighttime, holiday/weekend).
5. Program all time zones for all access control devices and cards.
6. Provide complete interface with video surveillance GUI and other subsystems.

3.05 CLIENT COORDINATION

- A. The contractor shall set up and participate in no fewer than four coordination meetings, with the Client or the Client's Representative, for determination of the Security System program and sequence of operation
- B. The Contractor shall provide an outline, in spreadsheet format, to the Client of the ACS device naming typology. The spreadsheet is to have a column with the labeling/address of each device, as originally entered into the head-end system, and a second blank column which will allow the client to create their own tag/labeling system or to input a short descriptive phrase to uniquely identify the equipment. A third column will allow the client to group/zone security devices
- C. Once this document is produced and finalized by the Client, the Contractor shall use the document in conjunction with these Specifications for programming of the ACS System
- D. The Contractor shall be available for response to any Client or Client Representative requested coordination issues related to the programming and sequence of operation of the Security System.
- E. Pre-Installation Meetings
 1. A pre-installation meeting is to be convened, including the Architect, Construction Manager, Security Contractor, Electrical Contractor, Door Hardware Supplier and Installer, and any other parties deemed necessary, in order to insure a complete coordination of the Security System work and its impact on other trades
 2. A security system coordination meeting is to be conducted at the time of the Security shop submission, with the Construction Manager, to insure coordination of the Security shop drawings prior to their submission to the Architect
- F. Job Conferences
 1. Job conferences are to be held as required while construction is in progress. The Contractor is to attend or be represented at all such meetings. Should the Contractor elect to be represented, it is to be understood and agreed upon that in dealing with the Contractor's representative, the full assurance that such representative's actions and commitments may be accepted as though the Contractor who signed and is bound by the Contract were himself present and personally made such agreements and commitments, in accordance with all terms and conditions of the Contract Documents. Representation will only be

allowed, if approved in advance, by the Construction Manager, Architect, and Owner.

2. Prior to Substantial Completion of the project and in ample time to address and resolve any coordination issues, the Contractor shall request and arrange meetings between the Owner, Owner's Vendors and Consultants, Architect and General Contractor to discuss the Scope of Work for each system being provided, and the interface required for a fully functional and operational system upon project completion. Initial meetings shall be scheduled three months prior to the scheduled Substantial Completion date, or as soon as Submittals are submitted and reviewed for projects with shorter schedules
 - a. At these meetings, the required interface shall be reviewed with the Owner, requests for information required to complete programming or for coordination shall be presented, and system operation and philosophy shall be discussed
 - b. Additional meetings shall be held as requested by any party so that all issues are resolved and with the goal and intent that all systems are fully operational and functional upon project Substantial Completion, and that the responsibility for all components required is clearly established

G. Sequencing

1. Coordinate the work of this Section with the respective trades responsible for installing interface work, and ensure that the work performed hereunder is acceptable to such trades for the installation of their work
2. Inform Architect immediately of any delays or potential delays. Furnish manufacturer's letter to verify order date, equipment delays, expected shipment date, order number, and potential remedies to speed up delivery. Any costs to speed up delivery shall be implemented at no cost to the project if the equipment or material was not ordered as soon as possible after Contract award

H. Scheduling

1. Refer to the overall scheduling of the work of the project. Schedule work, process Submittal and order materials and equipment is to conform to this schedule, and install work to not delay nor interfere with the progress of the project
2. Include premium time required to comply with the project scheduling and phasing
3. Be aware of, and plan for, project scheduling and phasing. Provide for complete continuous operation of all systems. Coordinate scheduling and phasing with the Architect, Owner, other Trades, and the General Contractor

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: The Contractor shall engage a qualified testing agency to perform tests and inspections with the Owner and appointed project manager.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.

1. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. **Tests and Inspections:**

1. **Inspection:** Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.
2. **Pretesting:** Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements.
3. **Test Schedule:** Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least fourteen (14) days. Provide a minimum of ten (10) days notice of test schedule.
4. **Operational Tests:** Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

- E. Access Control System shall be considered defective if it does not pass tests and inspections.

- F. Prepare test and inspection reports.

3.07 **ADJUSTING**

- A. **Occupancy Adjustments:** When requested within twelve (12) months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two (2) visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:

1. Check cable connections.
2. Check proper operation of access control devices.
3. Provide a written report of adjustments and recommendations.

3.08 **CLEANING**

- A. **Remove rubbish and debris:** Installation contractor is not allowed you use the onsite dumpster and is responsible to discard their own debris off site.
- B. **Clean installed items** using methods and materials recommended in writing by manufacturer.

3.09 **DEMONSTRATION – TRAINING**

- A. Bidding contractor shall engage a factory-authorized service representative to train the Owner's maintenance personnel to adjust, operate, and maintain Access Control system.

- B. Eight (8) hours of training shall be included as part of this specification. These training hours shall be partitioned into two (2) Four-Hour sessions or as the Owner mandates or as required.

****End of Section****

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SECTION 31 00 00

EXCAVATION, BACKFILL, COMPACTION AND DEWATERING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Excavation, backfill and compaction for subsurface utilities
2. Removal, handling and disposal of rock
3. Earth retention systems
4. Excavation, backfill and compaction for the abandonment of existing pipe
5. Temporary dewatering systems

B. Related Sections

1. Section 02 32 19, Subsurface Investigation
2. Section 02 11 00, Contaminated Soil Excavation
3. Section 31 23 33, Trenching and Backfilling
4. Section 31 25 00, Sediment and Erosion Control
5. Section 33 40 00, Storm Drainage

1.02 REFERENCES

- A. ASTM D1557-07 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
- B. ASTM D1556-07 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
- C. ASTM D2487-06e1 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- D. ASTM D6938-08a - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- E. 29 CFR Part 1926 Subpart P - OSHA Excavation Regulations 1926.650 through 1926.652 including Appendices A through F

1.03 DEFINITIONS

- A. Benching - A method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.
- B. Earth Retention Systems - Any structural system, such as sheeting and bracing or cofferdams, designed to retain in-situ soils in place and prevent the collapse of the sides of an excavation in order to protect employees and adjacent structures.
- C. Excavation - Any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.
- D. Protective System - A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include earth retention systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.
- E. Registered Professional Engineer - A person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.
- F. Shield System - A structure that is designed to withstand the forces imposed on it by a cave-in and thereby protects employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either pre-manufactured or job-built in accordance with 29 CFR 1926.652(c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."
- G. Sloping - A method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.
- H. Temporary Dewatering System – A system to lower and control water to maintain stable, undisturbed subgrades at the lowest excavation levels. Dewatering shall be provided for all pipelines, structures and for all other miscellaneous excavations.
- I. Trench - A narrow excavation (in relation to its length) made below the surface of the ground, of at least three feet in depth. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 m).

1.04 SUBMITTALS

- A. Drawings and calculations for each Earth Retention System required in the Work. The submittal shall be in sufficient detail to disclose the method of operation for each of the various stages of construction required for the completion of the Earth Retention Systems.
 - 1. Submit calculations and drawings for Earth Retention Systems prepared, signed and stamped by a Professional Engineer registered in the state where the work is performed.
- B. Performance data for the compaction equipment to be utilized
- C. Construction methods that will be utilized for the removal of rock
- D. Dewatering plan for the excavation locations.

1.05 QUALITY ASSURANCE

- A. All Excavation, Trenching, and related Earth Retention Systems shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926 Subpart P), and other State and local requirements. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply.
- B. The following test procedures will be performed by the Owner's inspection agency. Results will be submitted to the Engineer for review.
 - 1. Modified Proctor Test (ASTM D1557) results and soil classification (ASTM D2487) for all proposed backfill materials at the frequency specified below:
 - a. For suitable soil materials removed during excavation, perform one test for every 1,000 cubic yards of similar soil type. Similarity of soil types will be as determined by the Engineer.
 - 2. Compaction test results (i.e. ASTM D6938 or ASTM D1556) at a frequency of one test for every 100 cubic yards of material backfilled. The Engineer will determine the locations and lifts to be tested.
 - a. The Engineer may specify additional compaction testing when there is evidence of a change in the quality of moisture control or the effectiveness of compaction.
 - b. If all compaction test results within the initial 25% of the total anticipated number of tests indicate compacted field densities equal to or greater than 95% of maximum dry density at optimum moisture content, the Engineer may reduce frequency of compaction testing. In no case will the frequency be reduced to less than one test for every 500 cubic yards of material backfilled.

- c. The Contractor is cautioned that compaction testing by nuclear methods may not be effective where excavation sidewalls impact the attenuation of the gamma radiation or where oversized particles (i.e. large cobbles or coarse gravels) are present. In these cases, other field density testing methods may be required.
- C. Employ the services of a dewatering specialist or firm when well points, deep wells, recharge systems, or equal systems are required. Specialist shall have completed at least 5 successful dewatering projects of equal size and complexity and with equal systems.
- D. A Certificate of Clean Fill must be provided to Engineer and Owner for approval prior to delivery of any and all fill material including but not limited to mineral soil, borrow material, structural fill, processed fill material, loam, or top soil to be placed on site during the course of the Work. The Certificate must include laboratory analytical reports for all material to be used at the site on a basis of one sample per every 500 cubic yards or lesser portions thereof. Analytical reports must demonstrate that the proposed material does not contain detectable concentrations of contaminants including but not limited to; petroleum hydrocarbons, semi volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), pesticides, and/or herbicides and that metals listed in the Connecticut Remediation Standard Regulations do not exceed minimal concentrations deemed allowable by Engineer and Owner. No fill material shall be placed on site until Contractor has received approval from Engineer and/or Owner. Engineer and Owner reserve the right to collect and analyze samples from any proposed fill material prior to or after delivery to the site and to allow use of off-specification material at their sole discretion.

The Certificate must clearly state the following and be signed by and authorized signatory employed by the Contractor:

1. Volume of material to be used
2. Process by which the material was obtained
3. Location of origin and summary of current and past site uses of the location of origin
4. Statement from Contractor that the analytical reports included with the Certificate represent the specific material to be used at the site
5. Statement that Contractor does not know or have reason to believe that the proposed fill material contains foreign materials or contaminants.

1.06 PROJECT CONDITIONS

- A. Notify Call Before You Dig (CBYD) at 1-800-922-4455 or 811 and obtain CBYD identification numbers.
- B. Notify utility owners in reasonable advance of the work and request the utility owner to stake out on the ground surface the underground facilities and structures. Notify the Engineer in writing of any refusal or failure to stake out such underground utilities after reasonable notice.
- C. Make explorations and Excavations to determine the location of existing underground structures, pipes, house connection services, and other underground facilities in accordance with Section 02 32 19.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Fill material is subject to the approval of the Engineer and may be either material removed from excavations or borrow from off site. Fill material, whether from the excavations or from borrow, shall be of such nature that after it has been placed and properly compacted, it will make a dense, stable fill.
- B. Satisfactory fill materials shall include materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, SW, and SP.
- C. Satisfactory fill materials shall not contain trash, refuse, vegetation, masses of roots, individual roots more than 18 inches long or more than 1/2 inch in diameter, or stones over 6 inches in diameter. Unless otherwise stated in the Contract Documents, organic matter shall not exceed minor quantities and shall be well distributed.
- D. Satisfactory fill materials shall not contain frozen materials nor shall backfill be placed on frozen material.
- E. Excavated surface and/or pavement materials such as gravel or trap rock that are salvaged may be used as a sub-grade material, if processed to the required gradation and compacted to the required degree of compaction. In no case shall salvaged materials be substituted for the required gravel base.

2.02 DEWATERING MATERIALS

- A. Provide haybales and silt fence in accordance with Section 31 25 00.
- B. Provide silt filter bags (Dandy Dewatering Bag, Dirtbag, JMP Environ-Protection Filter Bag, or equal) of adequate size to match flow rate.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Public Safety and Convenience

1. Take precautions for preventing injuries to persons or damage to property in or about the Work.
- B. Provide safe access for the Owner's and Engineer's representatives at site during construction.
- C. Do not obstruct site drainage, natural watercourses or other provisions made for drainage, coordinate with Section 33 40 00.
- D. Install and maintain sediment and erosion controls in accordance Section 31 25 00.

3.02 CONSTRUCTION

A. Earth Retention Systems

1. Provide Earth Retention Systems necessary for safety of personnel and protection of the Work, adjacent work, utilities and structures.
2. Maintain Earth Retention Systems for the duration of the Work.
3. Systems shall be constructed using interlocking corner pieces at the four corners. Running sheet piles by at the corners, in lieu of fabricated corner pieces, will not be allowed.
4. Drive sheeting ahead of and below the advancing trench excavation to avoid loss of materials from below and from in front of the sheeting.
5. Sheeting is to be driven to at least the depth specified by the designer of the earth retention system, but no less than 2 feet below the bottom of the Excavation.
6. Remove sheeting, unless designated to be left in place, in a manner that will not endanger the construction or other structures. Backfill and properly compact all voids left or caused by the withdrawal of sheeting.
7. Remove earth retention systems, which have been designated by the Engineer to be left in place, to a depth of 3 feet below the established grade.

B. Excavation

1. Perform excavation to the lines and grades indicated on the Drawings. Backfill unauthorized over-excavation in accordance with the provisions of this Section, at no additional cost to the Owner.
2. Soils identified as contaminated as shown on the Soil Management Plan (Drawing C430), shall be excavated in accordance with the requirements of Section 02 11 00, Contaminated Soil Excavation.

3. Excavate with equipment selected to minimize damage to existing utilities or other facilities. Hand excavate as necessary to locate utilities or avoid damage.
3. Sawcut the existing pavement in the vicinity of the excavation prior to the start of excavation in paved areas, so as to prevent damage to the paving outside the requirements of construction.
4. During excavation, material satisfactory for backfill shall be stockpiled in an orderly manner at a distance from the sides of the excavation equal to at least one half the depth of the excavation, but in no case closer than 2 feet.
 - a. Excavated material not required or not suitable for backfill shall be removed from the site.
 - b. Perform grading to prevent surface water from flowing into the excavation.
 - c. Pile excavated material in a manner that will endanger neither the safety of personnel in the trench nor the Work itself. Avoid obstructing sidewalks and driveways.
 - d. Hydrants under pressure, valve pit covers, valve boxes, manholes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible until the Work is completed.
5. Make pipe trenches as narrow as practicable and keep the sides of the trenches undisturbed until backfilling has been completed. Provide a clear distance of 12 inches on each side of the pipe.
6. The final 6 inches of excavation and grading of the trench bottom shall be performed by hand so as not to disturb the material below the grade required for setting the pipe or appurtenances.
 - a. Where suitable bedding materials will be placed and compacted throughout the length of the trench, hand excavation of the final 6 inches will not be required.
 - b. Grade the trench bottom to provide uniform bearing and support for the bottom quadrant of each section of pipe.
 - c. Excavate bell holes at each joint to eliminate point bearing.
 - d. Remove stones greater than 6 inches in any dimension from the bottom of the trench to avoid point bearing.
7. If satisfactory materials are not encountered at the design subgrade level, excavate unsatisfactory materials to the depth directed by the Engineer and properly dispose of the material. Backfill the resulting extra depth of

excavation with satisfactory fill materials and compact in accordance with the provisions of this Section.

8. Where trenching and backfilling for a new pipe in place of an existing pipe along the same route, removal of the existing pipe shall be included under this item.

C. Backfill and Compaction

1. Unless otherwise specified or indicated on the Drawings, use satisfactory material removed during excavation for backfilling trenches. The Engineer may require stockpiling, drying, blending and reuse of materials from sources on the Project.
2. Spread and compact the material promptly after it has been deposited. When, in the Engineer's judgment, equipment is inadequate to spread and compact the material properly, reduce the rate of placing of the fill or employ additional equipment.
3. When excavated material is specified for backfill and there is an insufficient amount of this material at a particular location on the Project due to rejection of a portion thereof, consideration will be given to the use of excess material from one portion of the Project to make up the deficiency existing on other portions of the Project. Moving this excess material from one portion of the Project and placing it in another portion of the Project will be at no additional cost to the Owner.
 - a. Use borrow material if there is no excess of excavated material available at other portions of the Project.
4. Backfilling and compaction methods shall attain 95% of maximum dry density at optimum moisture content as determined in accordance with ASTM D1557.
5. Do not place stone or rock fragment larger than six inches in greatest dimension in the backfill.
6. Maximum loose lift height for backfilling existing or borrow material shall be 12 inches, unless satisfactory compaction is demonstrated otherwise to the Engineer through field-testing. In no case shall loose lift height for backfilling exceed 3 feet.
7. Do not drop large masses of backfill material into the trench endangering the pipe or adjacent utilities.
8. Install pipe in rock excavated trenches on a dense graded stone bedding with a minimum depth of 6 inches. Shape the stone bedding at the pipe bells to provide uniform support. Encase the pipe in the dense graded crushed stone bedding to a grade 6 inches over the top of the pipe and 12 inches on each side of the pipe.

9. Backfill from the bottom of the trench to the centerline of the pipe with the specified material. This initial backfill is to be placed in layers of no more than 6 inches and thoroughly tamped under and around the pipe. This initial backfilling shall be deposited in the trench for its full width on both sides of the pipe, fittings and appurtenances simultaneously.
 10. Electrical conduit not encased in concrete, shall be backfilled with sand borrow conforming to the requirements of Section 02320. The backfill shall be placed in the trench for its full width and shall extend to 12 inches over the pipe.
 11. Where excavation is made through permanent pavements, curbs, paved driveways or paved sidewalks, or where such structures are undercut by the excavation, place the entire backfill to sub-grade with granular materials and compact in 6 inch layers. Use approved mechanical tampers for the full depth of the trench. If required, sprinkle the backfill material with water before tamping so as to improve compaction.
 12. Place and compact backfill around manholes, vaults, pumping stations, gate boxes or other structures in six inch layers, from a point 1 foot over the pipe. Exercise care to protect and prevent damage to the structures.
 13. Install impervious trench dams where stone borrow is used for pipe bedding to prevent groundwater from following along the stone bedding. Install dams every 100 feet.
- D. Test Pit Excavation
1. General requirements of test pits are specified in Section 02 32 19.
- E. Dewatering
1. Provide, operate and maintain adequate pumping, diversion and drainage facilities in accordance with the approved dewatering plan to maintain the excavated area sufficiently dry from groundwater and/or surface runoff so as not to adversely affect construction procedures nor cause excessive disturbance of underlying natural ground. Locate dewatering system components so that they do not interfere with construction under this or other contracts.
 2. Take actions necessary to ensure that dewatering discharges comply with permits applicable to the Project. Dispose of water from the trenches and excavations in such a manner as to avoid public nuisance, injury to public health or the environment, damage to public or private property, or damage to the work completed or in progress. Coordinate dewatering requirements with Stamford WPCA in advance.
 3. Repair any damage resulting from the failure of the dewatering operations and any damage resulting from the failure to maintain all the areas of work in a suitable dry condition, at no additional cost to the Owner.

4. Exercise care to ensure that water does not collect in the bell or collar holes to sufficient depth to wet the bell or collar of pipes waiting to be jointed.
5. Take precautions to protect new work from flooding during storms or from other causes. Control the grading in the areas surrounding all excavations so that the surface of the ground will be properly sloped to prevent water from running into the excavated area. Where required, provide temporary ditches for drainage. Upon completion of the work, all areas shall be restored to original condition.
6. Brace or otherwise protect pipelines and structures not stable against uplift during construction.
7. Do not excavate until the dewatering system is operational and the excavation may proceed without disturbance to the final subgrade.
8. Unless otherwise specified, continue dewatering uninterrupted until the structures, pipes, and appurtenances to be installed have been completed such that they will not float or be otherwise damaged by an increase in groundwater elevation.
9. If open pumping from sumps and ditches results in "boils", loss of fines, or softening of the ground, submit a modified dewatering plan to the Engineer within 48 hours. Implement the approved modified plan and repair any damage incurred at no additional cost to the Owner.
10. Where subgrade materials are unable to meet the subgrade density requirements due to improper dewatering techniques, remove and replace the materials in accordance with suitable material as determined by the Engineer, at no additional cost to the Owner.
11. Notify the Engineer immediately if any settlement or movement is detected of survey points adjacent to excavations being dewatered. If settlement is deemed by the Engineer to be related to the dewatering, submit a modified dewatering plan to the Engineer within 24 hours. Implement the approved modified plan and repair any damage incurred to the adjacent structure at no additional cost to the Owner.
12. Dewatering discharge:
 - a. Install sand and gravel, or crushed stone, filters in conjunction with sumps, well points, and/or deep wells to prevent the migration of fines from the existing soil during the dewatering operation.
 - b. Transport pumped or drained water without interference to other work, damage to pavement, other surfaces, or property. Pump water through a silt filter bag prior to discharge to grade of drainage system.

- c. Do not discharge water into any sanitary sewer system.
 - d. Provide separately controllable pumping lines.
 - e. The Engineer reserves the right to sample discharge water at any time.
13. Install erosion/sedimentation controls for velocity dissipation at point discharges onto non-paved surfaces.
14. Removal
- a. Do not remove dewatering system without written approval from the Engineer.
 - b. Backfill and compact sumps or ditches with screened gravel or crushed rock.
 - c. Remove well points and deep wells. Backfill abandoned well holes with cement grout having a water cement ratio of 1 to 1 by volume.

****END OF SECTION 31 00 00****

SECTION 31 10 10

SITE PREPARATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Project Manual, apply to the Work of this Section.

1.02 SUMMARY

- A. Section includes
 - 1. Clearing and grubbing
 - 2. Disposal of materials
 - 3. Grading
 - 4. Stripping and stockpiling of soil and sod
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 31 25 00 – Sediment and Erosion Control
 - 2. Section 32 90 03 – Lawns and Grasses

1.03 SUBMITTALS

- A. Submit construction methods and equipment that will be utilized for the clearing, grubbing, and waste material disposal specified within this Section.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING

- A. Remove all site improvements conflicting with the proposed construction. Relocate those improvements as indicated on the drawings.
- B. Except as otherwise directed, cut, grub, remove and dispose of all trees, stumps, brush, shrubs, roots and any other objectionable material within the limits of the Work on the site and where required to construct the work.
- C. Protect trees or groups of trees, designated by the Engineer to remain, from damage by all construction operations by erecting suitable barriers, or by other approved means.

1. Conduct clearing operations to prevent falling trees from damaging trees designated to remain.
 2. All damage done to the trees by the Contractor's operation shall be trimmed and painted where cut as directed or as necessary to provide adequate vertical clearance for construction activities. The dressing or paint shall be applied no later than two days after the cuts are made.
 3. Use all necessary precautions to prevent injury to other desirable growth in all areas. Contractor shall assume full responsibility for any damage.
- D. Protect areas outside the limits of clearing from damage. No equipment or materials shall be stored in these areas.
- E. No stumps, trees, limbs, or brush shall be buried in fills or embankments.
- F. Where items with electrical power are to be removed, be sure to disconnect the power supply in accordance with City and utility requirements, and remove the structure in its entirety, including the base.

3.02 DISPOSAL OF MATERIALS

A. Vegetative Materials

1. Remove all tree trunks, limbs, roots, stumps, brush, foliage, other vegetation and objectionable material from the site and dispose of in a legal manner.
2. Burning or direct burial of cleared and grubbed materials on-site will not be permitted.

B. Other Materials

1. Remove other materials, such as stone walls within the limits shown on the plans in a manner as neat and workman-like as possible.
2. Protect adjacent surfaces and features to remain. Contractor is responsible for damage to features designated to remain.
3. Legally dispose of all removed materials off-site.

3.03 GRADING

- A. In preparation for placing loam, paved drives and appurtenances, perform grading to the lines, grades and elevations shown on the Drawings, and otherwise directed by the Engineer and perform in such a manner that the requirements for formation of embankments can be followed.
- B. All material encountered, regardless of its nature, within the limits indicated, shall be removed and disposed of as directed.

- C. During the process of grading, maintain the subgrade in such condition that it will be well drained at all times. Install temporary drains and drainage ditches to intercept or divert surface water that may affect the work when necessary.
- D. If at the time of grading it is not possible to place material in its final location, stockpile material in approved areas for later use. No extra payment will be made for the stockpiling or double handling of excavated material.
- E. The right is reserved to make minor adjustments or revisions in lines or grades if found necessary as the work progresses.
- F. Stones or rock fragments larger than 4 inches in their greatest dimensions will not be permitted in the top 12 inches of the finished subgrade of all fills or embankments except along the access roadways and rip-rap where shown on the Drawings.
- G. In cuts, loose or protruding rocks on the excavated slopes shall be barred loose or otherwise removed to line or finished grade of slope. Cut and fill slopes shall be uniformly dressed to the slope, cross-section and alignment shown on the Drawings or as directed by the Engineer.

3.04 STRIPPING AND STOCKPILING OF TOPSOIL AND SOD

- A. When excavating through existing grass, weed brush or tree-surfaced areas, strip and remove existing loam and surface materials.
- B. Machine-excavate and stockpile the removed material.
- C. Keep stockpile of removed material separate from the other stockpiles of excavated material.

****END OF SECTION 31 10 10****

SECTION 31 23 33

TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Project Manual, apply to the Work of this Section.

1.02 SUMMARY

- A. General: Perform trench excavation and backfill in accordance with the Contract Documents. The Work includes but is not limited to trench excavation and backfill to within five (5) feet of proposed building for the following:
 - 1. Storm drainage and utility services construction.
 - 2. Underground electrical distribution systems, except for direct burial cable Work.
 - 3. Provide temporary paving or surfacing such as stabilized crushed stone so that traffic may be restored as soon as possible after completion of utility Work.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 31 00 00 – Excavation, Compaction, Backfill and Dewatering
 - 2. Section 31 25 00 – Sediment and Erosion Control
 - 3. Section 33 40 00 – Storm Drainage
 - 4. Section 33 41 14 – Underground Warning Tape

1.03 COORDINATION

- A. Coordinate and schedule the work of this Section with all trades involved to prevent interference, and in order to allow adequate time at the proper stage of construction to properly perform all work of this Section.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials shall comply with State of Connecticut Department of Transportation Standard Specifications, Form 817, latest revision and all addenda thereto.

PART 3 - EXECUTION

3.01 EXCAVATION, TRENCHING AND BACKFILL

- A. General: Perform excavation to the depths shown or specified.
- B. Soils identified as contaminated as shown on the Soil Management Plan (Drawing C430), shall be excavated in accordance with the requirements of Section 02 11 00, Contaminated Soil Excavation.
- C. Where trenching operations take place in existing pavement, neatly sawcut the pavement to the dimensions shown on the plan to provide a clean, straight edge in the pavement to remain.
- D. During excavation, pile material suitable for backfilling in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins.
- E. Remove all excavated materials not required or suitable for backfill from the site.
- F. Grade as necessary to prevent surface water from flowing into trenches or other excavations. Remove any water accumulating therein by pumping or by other approved method.
- G. Install sheeting and shoring as necessary for the protection of the Work and for the safety of personnel.
- H. Unless otherwise indicated, excavation to be open cut.
- I. Excavation is classified as earth excavation and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered, pavements, and other obstructions visible on ground surface, underground structures, utilities and other items indicated to be demolished and removed, together with earth and other materials, excluding rock.
- J. Rock, for the purposes of classification shall consist of rock material in beds, ledges, unstratified masses, conglomerate deposits and boulders of rock material that exceed 1 cubic yard that cannot be removed by rock excavating equipment without systematic drilling, ram hammering, ripping or blasting. Rock excavating equipment is defined as a late-model, track-mounted, hydraulic excavator equipped with a 42-inch wide, maximum, short-tip radius rock bucket, rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,090 lbf and stick-crowd force of not less than 18,650 lbf; measured according to SAE J-1179.

- K. Backfill and surface excavations for utilities occurring in or across streets or sidewalks with temporary paving or crushed stone as soon as possible after Work is completed.
- L. Maintain temporary paving or surfacing in a condition acceptable to the Owner until permanent pavement can be installed.

3.02 SIZES OF TRENCHES

- A. Ensure trenches are the necessary width for the proper laying of the pipe, and ensure the banks areas nearly vertical as practicable.
- B. Accurately grade the bottom of the trenches to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its entire length.
- C. Except where rock is encountered, take care not to excavate below the depths indicated or specified.
- D. Where rock excavations are required, excavate the rock to a minimum overdepth of 6 inches below the trench depths indicated on the drawings or specified.
- E. Backfill overdepths in the rock excavation and unauthorized overdepths with thoroughly compacted sand or gravel as specified.
- F. Whenever wet or otherwise unstable soil that is incapable of properly supporting the pipe, as determined by the Owner's Geotechnical Consultant, is encountered in the bottom of the trench, remove such soil to the depth required and backfill the trench to the proper grade with coarse sand, fine gravel or other suitable material.
- G. Ensure trenches for utilities are of a depth that will provide the following minimum depths of cover from existing grade or from indicated finished grade, whichever is lower, unless otherwise specifically shown:
 - H. 4.5 feet minimum cover for water lines, sanitary sewers; gas mains and the like carrying fluids.
 - I. 2 feet minimum cover for electrical and telephone conduit and storm drains.
 - J. For bedding of piping, ensure the width of the trench at and below the top of the pipe is such that the clear space between the barrel of the pipe and the trench wall is between 6 and 12 inches on either side of the pipe.
 - K. Ensure the width of the trench above the pipe crown is as wide as necessary for sheeting and bracing and the proper performance of the Work.

3.03 EXISTING UTILITY LINES

- A. Contact "Call Before You Dig" at 1-800-922-4455 at least two working days in advance of any construction to verify the location of utilities.

- B. Protect existing utility lines from damage during excavation and backfilling. If such lines are damaged, the Contractor will repair at his expense.

3.04 BACKFILL RESTRICTIONS AND REQUIREMENTS

- A. Do not backfill trenches until all required pressure and other tests have been performed and until the utilities systems as installed conform to the requirements of the drawings and specification.
- B. Carefully backfill the trenches with the excavated materials approved for backfilling consisting of earth, loam, sand, sand and gravel, soft shale or other approved materials, free from large clods of earth, stones over 2-1/2 inches maximum dimension, or other undesirable material. Deposit backfill in 6 inch layers then thoroughly and carefully tamp until the pipe has a cover of not less than one (1) foot.
- C. Place underground warning tape as required.
- D. Carefully place the remainder of the backfill material in the trench in one foot layers and tamp. Settling the backfill with water is not permitted.
- E. Grade the surface to a reasonable uniformity and leave the mounding over trenches in a uniform and neat condition.
- F. The Engineer may reject any on-site or borrow materials which he considers unsuitable for intended backfill or fill usage.
- G. Under all paved areas, compact the fill and/or backfill to 95% of the maximum density at optimum moisture when tested in accordance with ASTM Designation D1557.
- H. Perform field density tests by the approved Soil Testing Laboratory at locations and elevations as directed. In general, take test samples for every 250 cubic yards of fill or backfill placed or at 100 linear foot intervals of trench backfilled.
- I. Backfill trenches excavated under footings and within 18 inches of bottom of footings with compacted select backfill; fill with concrete to elevation of bottom of footings.

3.05 TRAFFIC CONTROL

- A. Maintain access for construction vehicles, equipment and personnel to facilitate construction activities occurring concurrently with trenching and backfilling activities.

****END OF SECTION 31 23 33****

SECTION 31 25 00

EROSION AND SEDIMENT CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and other Division 01 Specifications, apply to this section.

1.02 SUMMARY

- A. General: Provide required erosion and sedimentation controls in accordance with the Contract Documents.
- B. Conduct operations at all times in conformity with all federal, state and local permit requirements concerning water, air, or noise pollution.
- C. The Site Contractor to coordinate the requirements of the Sedimentation and Erosion Control Plan in compliance with federal, state and local requirements.
- D. The Site Contractor to be responsible for, and hold the General Contractor, Owner and Owner's Consultants harmless from, any penalties or fines which may be assessed by any authority due to his failure to comply with the terms of all applicable permits and approval requirements.
- E. Related Sections include the following:
 - 1. Section 31 00 00 – Excavation, Backfill, Compaction and Dewatering
 - 2. Section 31 23 33 – Trenching and Backfilling
 - 3. Section 33 11 00 – Water Utility Distribution Piping
 - 4. Section 33 40 00 – Storm Drainage
 - 5. Section 33 71 19 – Electrical Underground Ducts and Manholes

1.03 COORDINATION

- A. Thoroughly coordinate and schedule the work of this Section with all trades involved to prevent interference, and in order to allow adequate time at the proper stage of construction to properly perform all work of this Section.

1.04 REQUIREMENTS AND RESTRICTIONS

- A. Control and abate siltation, sedimentation, erosion and pollution of all waters, and underground water systems, throughout the life of the contract.
- B. Do not refuel equipment or machinery within twenty-five (25) feet of any watercourse or storm drainage system inlet.
- C. When dewatering surface runoff is necessary, do not discharge pumps directly into the site drainage system or the adjacent City drainage system. Prior to dewatering, submit to the Owner and the Engineer a written proposal for specific methods and devices to be used, and obtain the Engineer's approval of such methods and devices to be used, including but not limited to, pumping the water into a temporary sedimentation bowl, installation of sump pits, providing surge protection at the inlet and outlet of pumps, or floating the intake of the pump, or other methods to minimize and retain the suspended solids.
- D. Do not dump oil, chemicals or other deleterious materials on the ground. Provide a means of catching, retaining, and properly disposing of drained oil, removed oil filters, or other deleterious material. All spills of such materials shall be reported immediately to the CTDEEP.
- E. Do not apply herbicides or pesticides within twenty-five (25) feet of any storm or drainage inlet.
- F. Inspect temporary and permanent erosion and sedimentation controls immediately after each rainfall and at least daily during prolonged rainfall. Maintain all erosion and sedimentation control devices in accordance with the Contract Documents and the 2002 "Connecticut Erosion and Sediment Guidelines", CTDEEP Bulletin No. 34, as revised. In the event that such devices are not maintained in accordance with these documents, and the failures are not corrected within 48 hours after receipt of written notice, the Owner may proceed to remedy the failures specified in the notice. The cost thereof will be deducted from monies due the Site Contractor under the contract or under any other contract.

1.05 SUBMITTALS

- A. Submit, in writing, a construction sequencing plan and a water handling plan, including a contingency plan for flood events, to be reviewed and actioned by the Engineer and Owner prior to the commencement of any construction.
- B. Contractor to file standard contractor's compliance statement with EPB.
- C. Maintain effective erosion controls as needed until site is stabilized.
- D. All work to be confined to the specified contract limits with no clearing excavation or deposition of fill to take place within regulated areas outside of the project.
- E. Provisions for dewatering to require clean discharges to all surface waters.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Materials required for the Work of this Section shall be as specified herein or in the City of Stamford Standard Specifications and/or the State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction, Form 817, 2016 Edition, and latest addenda thereto.

PART 3 - EXECUTION

3.01 GENERAL

- A. The Site Contractor to be responsible for all control measures.
- B. Install all sedimentation and erosion control measures as defined on the "sedimentation and erosion control plans" and/or as required by the Owner, a Representative of the City of Stamford or Connecticut Department of Energy and Environmental Protection (CTDEEP).
- C. Provide adequate protection or complete the grading and placement of topsoil, seed or sod as specified without delay on areas that may be potential contributors to pollution of storm drains and or cause damage because of sedimentation. Where areas are seeded or sodded, provide required maintenance and repair until final acceptance.
- D. Remove all sedimentation and erosion control devices upon completion of construction and approval of the Owner, the City of Stamford and Connecticut DEEP.

3.02 HAY BALES

- A. Place hay bales in locations shown on the plans or as directed by the Engineer. Place hay bales lengthwise with ends of adjacent bales tightly abutting one another. Install all bales so that bindings are oriented around the sides, rather than along the tops and bottoms. Entrench bales 4 inches and backfill, with the backfilled soil placed toward the potential silt source. Hold them in place by two wooden stakes in each bale, with loose straw inserted in voids between the bales. Maintain or replace bales until they are no longer necessary for the purpose intended or are ordered removed by the Engineer. Perform cleanout of accumulated sediment once one-half (1/2) of the original height of the bales as installed becomes filled with sediment or as directed by the Engineer.

3.03 FILTER FABRIC SILT FENCE

- A. Filter fabric sedimentation control systems may consist of either a prefabricated filter fabric fence or a field-assembled filter fabric fence. Install filter fabric sedimentation control systems so that the bottom six inches of the fabric is buried by either trenching or by laying the six inch section horizontally on the ground

and burying by ramping the soil up to the control fence. Install all filter fabric fences with at least 30 inches in exposed height, with not less than a 2 degree and not more than a 20 degree inclination toward the potential silt source. Hardwood posts shall have a minimum cross-section size of at least 1.5 inches by 1.5 inches and a minimum length of 42 inches. Steel posts shall be at least 0.5 pound per linear foot with a minimum length of 48 inches. Spacing between posts shall not exceed 10 feet, and drive all posts 12 inches into the ground at minimum. When joints between sections of filter fabric sedimentation control systems are necessary, splice filter fabric together only at a support post, with a minimum 6 inch overlap, and seal securely.

3.04 CONSTRUCTION ENTRANCE

- A. Install construction entrance at the locations shown on the plans.
- B. Clear the area of the construction entrance of all vegetation, roots, and other objectionable material. Place the stone to the specified dimensions.
- C. Maintain the pads in a condition that prevents tracking or flow of mud onto public rights-of-way. This may require periodic top dressing with CTDOT No. 3 stone, as conditions demand, and repair and/or cleanout of any structures used to trap sediment. Remove all material spilled, dropped, washed, or tracked from vehicles onto roadways or into storm drains immediately.

3.05 DUST CONTROL

- A. Exercise every reasonable precaution throughout the life of the Contract to minimize dust arising from construction operations, hauling, storage and demolition.
- B. Establish vegetative cover as soon as possible.
- C. Spray haul roads with water or a chemical dust palliative solution.
- D. Sweep paved roads with a vacuum type sweeper.
- E. Keep equipment speeds low on unpaved surfaces.
- F. Use water when drilling with track drills to limit the airborne movement of dust.

3.06 SILTSACK®

- A. Install SILTSACK® in catch basins at the locations shown on the plans.
- B. Install the SILTSACK® in the catch basin by removing the grate and placing the sack in the opening. Hold approximately 6 inches of the sack outside the frame. This is where the lifting straps are located. Replace the grate to hold the sack in place.
- C. Remove the SILTSACK® by taking two pieces of 1" diameter rebar and placing them through the lifting loops on each side of the sack to facilitate the lifting of the SILTSACK®.

- D. Empty the SILTSACK® when the restraint cord is no longer visible. Place it where the contents will be collected. Place the rebar through the lift straps (connected to the bottom of the sack) and lift, turning the SILTSACK® inside out and emptying the contents. Clean out and rinse. Return the SILTSACK® to its original shape and replace in the basin.

3.07 STRAW WATTLES

- A. Secure with wooden stakes placed in accordance with manufacturer specifications.
- B. Remove trapped sediment as needed.

****END OF SECTION 31 25 00****

SECTION 32 12 16

BITUMINOUS CONCRETE PAVEMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Bituminous concrete paving, temporary and permanent, wearing, binder and base course.
- B. Related Sections
 - 1. Section 31 00 00 - Excavation, Backfilling, Compaction and Dewatering
 - 2. Section 32 16 13 - Curbing

1.02 REFERENCES

- A. State of Connecticut Department of Transportation "Standard Specifications for Roads, Bridges and Incidental Construction Form 817, 2016 Edition as amended to date.
- B. AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 1990 Edition, as amended.
- C. ASTM D446 – Standard Specifications and Operating Instructions for Glass Capillary Kinematic Viscometers
- D. ASTM D2939 – Standard Test Methods for Emulsified Bitumens Used as Protective Coatings
- E. AASHTO M 81
- F. AASHTO M 82
- G. AASHTO M 116
- H. AASHTO M 140
- I. AASHTO M 144
- J. AASHTO M 173
- K. AASHTO M 208
- L. AASHTO M 226
- M. AASHTO T 44
- N. AASHTO T 55

- O. AASHTO T 96 – L.A. Abrasion Test
- P. AASHTO T 195 (Ross Count)
- Q. TAI - (The Asphalt Institute) - MS-3 Asphalt Plant Manual.
- R. TAI - (The Asphalt Institute) - MS-8 Asphalt Paving Manual.

1.03 SUBMITTALS

- A. Product information and mix design for each mix specified under this Section.
- B. Product data sheets for all additives proposed in the mix design.
- C. Certificate indicating the mixes specified meet or exceed the requirements specified herein.
- D. Certificate indicating the mix plant conforms to State of Connecticut Department of Transportation “Standard Specifications for Roads, Bridges and Incidental Construction”, Form 817.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Connecticut Department of Transportation “Standard Specifications for Roads, Bridges and Incidental Construction Form 817.
- B. Mixing Plant: Conform to State of Connecticut Department of Transportation “Standard Specifications for Roads, Bridges and Incidental Construction Form 817.
- C. Obtain materials from same source throughout.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Parking Lot and Driveway Paving
 - 1. Wearing course shall be Superpave 0.375 as specified in the State of Connecticut Department of Transportation “Standard Specifications for Roads, Bridges and Incidental Construction” Form 817, Article M.04.02.
 - 2. Surface course shall be Superpave 0.5 as specified in Article M.04.02 of CTDOT Form 817.
 - 3. Processed Aggregate shall be as specified in Article M.05 of CTDOT Form 817.
- B. Tack Coat

1. Anionic emulsified asphalts shall conform to the requirements of AASHTO M-140(M). Materials used for tack coat shall not be diluted and meet grade RS-1 or SH-1H. When ambient temperatures are 80^o F and rising, grade SS-1 or SS-IH may be substantiated if permitted by the Engineer.
2. Cationic emulsified asphalts shall conform to the requirements of AASHTO M-208. Materials used for tack coat shall not be diluted and meet grade CRS-1. When ambient temperatures are 80^o F and rising, grade CSS-1 or CSS-IH may be substantiated if permitted by the Engineer.

C. Subbase

1. Subbase shall conform to the requirements of Article M.2.02 and M.2.06 of CTDOT Form 817.

PART 3 EXECUTION

3.01 PAVING – TEMPORARY

- A. Install temporary pavement over trenches or other areas as ordered by the Engineer or Owner.
- B. Temporary pavement shall be placed over trenches that are compacted in accordance with the Contract Drawings.
- C. Temporary pavement shall be removed prior to placement of final pavement, and shall be removed by sawcutting to neat lines. Sawcutting and removal of temporary pavement shall be included in the price of the unit item.

3.02 PAVING - GENERAL

- A. Install bituminous concrete pavement in accordance with State of Connecticut Department of Transportation “Standard Specifications for Roads, Bridges and Incidental Construction Form 817.
- B. Place binder course as soon as possible after the gravel base has been prepared, shaped and compacted for City streets and driveway/sidewalk repair.
- C. Place and compact binder course by steel-wheeled rollers of sufficient weight to thoroughly compact the bituminous concrete.
- D. Maintain pavement under this Contract during the guarantee period of one year and promptly (within 3 days of notice given by the Engineer) refill and repave areas which have settled or are otherwise unsatisfactory for traffic.
- E. All pavement thicknesses referred to herein are compacted thicknesses. Place sufficient mix to ensure that the specified thickness of pavement occurs wherever called for.

- F. In no case will pavement be placed until the gravel base is dry and compacted to at least 95% maximum density at optimum moisture content.
- G. No mix shall be placed on wet or damp surfaces. When surface and ambient temperatures are 15°C and rising, use mix prepared and placed in accordance with the specified requirements of the mix hereinbefore designated as OGFC.
- H. Regardless of any temperature requirements, no mix conforming to the requirements of these specifications shall be placed after October 31 or before May 1 of any year, unless approved by the Owner.
- I. Furnish and spread calcium chloride on disturbed surfaces to control dust conditions.
- J. The contact surfaces of curbing, castings, and other structures shall be painted with a tack coat prior to placement of paving.
- K. Along curbs, structures and all other places not accessible with a roller, the paving mixture shall be thoroughly compacted with tampers. Such tampers shall not weigh less than 25 pounds and shall have a tamping face no more than 50 square inches in size. The surface of the mixture after compaction shall be smooth and true to the established line and grade.
- L. When the air temperature falls below 50°F, extra precautions shall be taken in drying the aggregates, controlling the temperatures of the materials and placing and compacting the mixtures.
- M. No mixtures shall be placed when the air temperature is below 40°F, or when the material on which the mixtures are to be placed contains frost or has a surface temperature ENGINEER considers too low.
- N. No vehicular traffic or loads shall be permitted on the newly completed pavement until adequate stability has been attained and the material has cooled sufficiently to prevent distortion or loss of fines. If the climatic or other conditions warrant it, the period of time before opening to traffic may be extended at the discretion of the Engineer.
- O. Existing drainage patterns shall not be altered by the new pavement construction unless otherwise shown on the Drawings.
- P. Maintain binder course in a condition suitable for traffic throughout the construction period. Defects shall be repaired within 3 days of notification.
- Q. Prepare the binder course for placement of the top course. The binder course shall be regraded, placing additional bituminous concrete where settling has occurred, repairing the existing surface and replacing broken or damaged sections at no additional cost to the Owner. The binder course surface shall be in all respects acceptable to the Engineer before the final pavement is placed. The surface shall then be broom cleaned.

- R. Following preparation of the binder course, apply the tack coat at 0.10 gallons per square yard and place the top course.
- S. Apply joint adhesive to all longitudinal joints for proper adhesion of the new bituminous concrete pavement to the existing.
- T. Pavement markings damaged during the course of the work shall be repaired.
- U. Following all paving, the area along the edge of all pavement, sidewalks, berms, waterways, etc. shall be backed up with gravel, or loam and seed as required, so that it is flush with the adjacent paving. Whenever possible, the final surface of the backup material shall slope away from the surface edge to allow proper sheeting of runoff.

****END OF SECTION 32 12 16****

SECTION 32 16 13

CURBING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Curbing of the type specified.
- B. Related Sections
 - 1. Section 31 00 00 - Excavation, Backfilling, Compaction and Dewatering
 - 2. Section 32 12 16 Bituminous Concrete Pavement
 - 3. Section 32 16 23 Sidewalks

1.02 REFERENCES

- A. State of Connecticut Department of Transportation "Standard Specifications for Roads, Bridges and Incidental Construction Form 817, 2016 Edition as amended to date.
- B. AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 1990 Edition, as amended.

1.03 SUBMITTALS

- A. Product information and mix design for each mix specified under this Section.
- B. Product data sheets for all additives proposed in the mix design.
- C. Certificate indicating the mixes specified meet or exceed the requirements specified herein.
- D. Certificate indicating the mix plant conforms to State of Connecticut Department of Transportation "Standard Specifications for Roads, Bridges and Incidental Construction", Form 817.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Connecticut Department of Transportation "Standard Specifications for Roads, Bridges and Incidental Construction Form 817.
- B. Mixing Plant: Conform to State of Connecticut Department of Transportation "Standard Specifications for Roads, Bridges and Incidental Construction Form 817.

- C. Obtain materials from same source throughout.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Bituminous Concrete Curbing
 - 1. Material for bituminous concrete curbing shall be Curb Mix conforming to Article M.04 of CTDOT Form 817.
- B. Tack Coat
 - 1. Anionic emulsified asphalts shall conform to the requirements of AASHTO M-140(M). Materials used for tack coat shall not be diluted and meet grade RS-1 or SH-1H. When ambient temperatures are 80⁰ F and rising, grade SS-1 or SS-IH may be substantiated if permitted by the Engineer.
 - 2. Cationic emulsified asphalts shall conform to the requirements of AASHTO M-208. Materials used for tack coat shall not be diluted and meet grade CRS-1. When ambient temperatures are 80⁰ F and rising, grade CSS-1 or CSS-IH may be substantiated if permitted by the Engineer.
- C. Cast-in-Place Concrete Curbing
 - 1. Concrete for cast-in-place or slip formed curbing shall be Class "F" concrete meeting the pertinent requirements of Form 817, Section M.03.
 - 2. Joint filler shall meet the requirements of Form 817, Subarticle M.03.08-2.
 - 3. Subbase material shall conform to the requirements of Section 32 12 16 of these specifications.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine all work prepared by others to receive work of this Section and report any defects affecting installation to the Site Contractor for correction. Commencement of work will be construed as complete acceptance of preparatory work by others.
- B. Curbing that has been damaged shall be removed from the project at the Contractor's expense.

3.02 BITUMINOUS CONCRETE CURBING

- A. Clean the surface to which the curbing will be applied of all loose and foreign substances.

- B. Curbing shall be applied only to dry and clean surfaces.
- C. Apply tack coat to surface where curbing will be installed.
- D. Keep mixture clean and free of dirt and foreign materials at all times.
- E. Confirm the alignment of the curbing face by applying a 10-foot straight edge. Variations exceeding $\frac{1}{4}$ inch shall be satisfactorily corrected.
- F. The only compaction required shall be that obtained by the mechanical curbing machine.
- G. Where machine work is impractical, the Engineer may permit hand-laid curbing.
- H. If the design of the curbing machine is such that the outside wheels operate outside of the curb, the Contractor shall be required to obtain a smooth surface by grading and consolidating the area on which the outside wheel of the machine rides, and this work shall be done at the Contractor's expense.
- I. After the completion of curbing, traffic shall be kept at a safe distance for not less than 24 hours and until the curbing has set sufficiently.

3.03 CAST-IN-PLACE CONCRETE CURBING

- A. Construction shall be in accordance with CTDOT Form 817, Article 6.01.03, and as supplemented herein.
- B. Excavation: Excavation shall be made to the required depth, and the base upon which the curbing is to be set shall be compacted to a firm, even surface.
- C. Section Lengths: All curbing sections shall have uniform length of approximately 10 ft, unless otherwise directed. The length of straight curb sections may be varied slightly where necessary for closures, but no section less than 6 ft long will be permitted.
- D. Concrete shall be placed in clean forms on a moist, firm, unfrozen base. The concrete shall be placed and finished to a smooth, even surface. Where forms are used, they shall be so constructed that the form for exposed faces may be removed before the concrete has taken final set in order to permit finishing.
- E. Backfilling: The grading shall be completed to the lines shown on the plans, or as ordered, by refilling to the required elevation with approved material which shall be placed in layers of not over 6 in deep and shall be thoroughly compacted.
- F. Openings: Where indicated on the plans, or directed, openings shall be made through the curbing at the elevations and of the size required.

****END OF SECTION 32 16 13****

SECTION 32 12 23

SIDEWALKS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Sidewalks and sidewalk ramps of the materials, dimensions, types and locations specified on the Drawings.
- B. Related Sections
 - 1. Section 31 00 00 - Excavation, Backfilling, Compaction and Dewatering
 - 2. Section 32 16 13 - Curbing

1.02 REFERENCES

- A. State of Connecticut Department of Transportation "Standard Specifications for Roads, Bridges and Incidental Construction Form 817, 2016 Edition as amended to date.
- B. AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 1990 Edition, as amended.

1.03 SUBMITTALS

- A. Product information and mix design for each mix specified under this Section.
- B. Product data sheets for all additives proposed in the mix design.
- C. Certificate indicating the mixes specified meet or exceed the requirements specified herein.
- D. Certificate indicating the mix plant conforms to State of Connecticut Department of Transportation "Standard Specifications for Roads, Bridges and Incidental Construction", Form 817.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Connecticut Department of Transportation "Standard Specifications for Roads, Bridges and Incidental Construction Form 817.
- B. Mixing Plant: Conform to State of Connecticut Department of Transportation "Standard Specifications for Roads, Bridges and Incidental Construction Form 817.
- C. Obtain materials from same source throughout.

PART 2 PRODUCTS

2.01 MATERIALS

A. Bituminous Concrete

1. Bituminous concrete surface shall be HMA S0.375 as specified in the State of Connecticut Department of Transportation "Standard Specifications for Roads, Bridges and Incidental Construction" Form 817, Article M.04
2. Subbase shall be gravel or reclaimed aggregate meeting the requirements of Article M.02.01 of CTDOT Form 817 for granular fill.

B. Portland Cement Concrete

1. Portland cement concrete shall conform to the requirements of Article M.03.01, Class F Concrete, Connecticut Department of Transportation Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817, latest edition, and all addenda thereto, except:
 - a. The concrete shall not contain less than 5% or more than 7% entrained air at the time the concrete is deposited into forms.
2. Air-entraining admixtures shall conform to the requirements of Article M.03.01, Class F Concrete, Connecticut Department of Transportation Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817, latest edition, and all addenda thereto.

C. Granular Fill Base

1. Granular fill shall conform to the requirements of Article M.02.01, Connecticut Department of Transportation Standard Specifications for Roads, Bridges, and Incidental Construction, Form 817, latest edition, and all addenda thereto.

D. Expansion Joint Filler

1. Premolded expansion joint filler shall meet the requirements of AASHTO Designation M153, Type II and AASHTO M 213.

E. Sheet Membrane Curing Compounds

1. Sheet membrane curing compounds shall meet the requirements of ASTM C 309.

F. Welded Wire Fabric

1. Welded wire fabric shall conform to ASTM A185.

G. Detectable Warning Tile

1. Raised truncated domes with a diameter of nominal 0.9 inches, a height of nominal 0.2 inches, and a center-to-center spacing of nominal 1.67 inches minimum and 2.35 inches maximum.
2. Provide surface mount panel of the size and dimensions indicated on the plan, a minimum of 3/16 inches thick.
3. Edges to have ½ inch bevel.
4. Manufacturer shall be the following, or approved equivalent:
 - a. ADA Solutions, Inc.
P.O. Box 3
North Billerica, MA 01862
(800) 372-0519
5. Material:
 - a. Homogeneous glass and carbon reinforced composite, colorfast and ultraviolet light stable.
 - b. truncated domes shall be fiberglass reinforced.
 - c. Color shall be inherent to material and shall not be achieved by paint coating.
 - d. Physical characteristics:
 - (1) Compressive strength of 28,900 psi per ASTM D695.
 - (2) Flexural strength of 29,300 psi per ASTM D790.
 - (3) Slip Resistance of 1.18 Dry, 1.05 Wet per ASTM C1028.
 - (4) Water Absorption of 0.07% per ASTM D570.
 - (5) Flame Spread Index of 20 per ASTM E84.
 - (6) Salt Spray showing No Change in 200 hours, per ASTM B117
 - (7) Chemical Stain testing showing no deterioration per ASTM 1308.
 - (8) Abrasion Resistance of 549 per ASTM C501.

- (9) Accelerated Weathering showing Delta E of less than 5.0 for 2,000 hours per ASTM G155.
 - (10) Tensile Strength of 11,600 psi per ASTM D638.
 - (11) Adhesion to Concrete (20°-180°) showing no delamination or degradation per ASTM C903.
 - (12) Freeze/Thaw/Heat showing no disintegration per ASTM C1026.
- 6. Fasteners: As recommended by the manufacturer.
 - 7. Adhesive: As recommended by the manufacturer.
 - 8. Sealant: As recommended by the manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

- A. Shape the subgrade parallel to the proposed surface and compact thoroughly. Fill depressions with suitable material and compact again until the surface is smooth and hard.
- B. Install a granular fill base to a depth shown on the plans on top of the subgrade. Fine grade the granular fill base and compact thoroughly with approved mechanical tampers.
- C. Completely remove mortar and dirt from forms that have been previously used. The forms shall be well staked and thoroughly graded and set to the established lines with their upper edge conforming to the grade of the finished walk. Oil forms before placing concrete.
- D. Place Portland cement panels to the thicknesses shown on the drawings in accurately set, smooth wooden or steel forms of sufficient strength to resist springing out of shape. The granular fill base shall be fine graded and recompact immediately ahead of pouring the concrete. Sidewalks shall match the top of the existing adjacent sidewalk panels.

3.02 BITUMINOUS CONCRETE SIDEWALK

- A. Excavation, including saw cutting, removal of any existing sidewalk or driveway shall be made to the required depth below the finished grade, as shown on the plans or otherwise directed by the Engineer.
- B. Where bituminous concrete is applied by hand, forms of metal or wood shall be used. Such forms shall be free from warp and of sufficient strength to resist springing from the impact of the roller.

- C. Uniformly spread base course material to the required depth and thoroughly compact with a roller with a weight of at least 500 pounds.
- D. Bituminous concrete surface shall be constructed under the requirements of Section 32 12 16
- E. Backfill the sides of the sidewalk with suitable material, thoroughly compacted and finished flush with the top of the sidewalk, unless otherwise directed or indicated.
- F. Remove all surplus material.

3.03 CONCRETE SIDEWALK AND RAMPS

- A. Place concrete to half the desired depth at which point the welded wire fabric shall be placed or raised to the surface.
- B. Place the remaining concrete. Care should be exercised to avoid walking in areas with reinforcing.
- C. No finish work shall be performed while free water is present. After water sheen has disappeared and concrete has started to stiffen, edging operations, where required, shall be completed.
- D. After edging and joining operations, the surface shall be floated. Immediately following floating, the surface shall be steel-troweled. Following troweling, the concrete sidewalk shall be given a stiff broom finish, perpendicular to the primary direction of pedestrian travel..
- E. One of two methods of curing may be employed:
 - 1. Cure the concrete by covering with burlap or other acceptable material that shall be kept moist for at least five (5) days after placing the concrete, or
 - 2. Cure the concrete by the application of a liquid membrane-curing compound as soon as free water has disappeared and the surface cannot be marred. The application should be uniform and without puddles.
- F. Install detectable warning tile in accordance with manufacturer's instructions.

****END OF SECTION 32 16 23****

SECTION 32 17 23

PAINTED PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Project Manual, apply to the Work of this Section.

1.02 SUMMARY

- A. This Section includes, but is not limited to the following:
 - 1. Painted legends
 - 2. Painted parking lines
 - 3. Painted cross-hatching
- B. General: Furnish and install painted pavement markings, of the type and color shown on the plans.

1.03 COORDINATION

- A. Thoroughly coordinate and schedule the work of this Section with all trades involved to prevent interference, and in order to allow adequate time at the proper stage of construction to properly perform all work of this Section.

PART 2 - PRODUCTS

2.01 EPOXY RESIN

- A. Conform to the requirements of the State of Connecticut, Department of Transportation Standard Specifications Form 817, latest edition and addenda thereto, Article M.07.22.

2.02 GLASS BEADS

- A. Conform to the requirements of the State of Connecticut, Department of Transportation Standard Specifications Form 817, latest edition and addenda thereto, Article M.07.30 for glass beads. In case of conflict with any part or parts of these specifications, the appropriate item specification below takes precedence, and governs.

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS

- A. Where conflicting with new pavement markings, existing pavement markings shall be removed from the pavement by any method that does not materially damage the surface or texture of the pavement. Any damage to the pavement surface caused by pavement marking removal shall be repaired by the Contractor at its expense by methods acceptable to the Engineer. Sand or other material deposited on the pavement as a result of removing pavement markings shall be removed as the work progresses. Accumulations of sand or other material which might interfere with drainage or might constitute a hazard to traffic will not be permitted. Layout pavement markings in the field and contact the Owner and Engineer to review field layout for acceptability.
- B. Sufficiently clean sand and road debris from dry pavement areas scheduled for painting, providing an acceptable bond between the paint and the pavement. This shall be accomplished by using a power washing machine capable of cleaning the pavement with a pressure of 2,400 to 2,800 psi, with water heated to between 180 and 195°F. No chemicals shall be added to the water used in the process. The power washer shall be equipped with a turbo blast tip with an oscillating head and shall be capable of supplying a minimum of 5 gal./minute at the gun.
- C. All surfaces that are power washed shall be allowed to dry sufficiently prior to the application of the epoxy markings. The areas to be marked shall be broom cleaned immediately prior to the application of the epoxy markings.
- D. Operations shall be conducted only when the road surface temperature is at least 40°F or as allowed by the Engineer. They shall be discontinued during periods of rain, and shall not continue until the Engineer determines that the pavement surface is dry enough to achieve adhesion.
- E. The epoxy shall be uniformly applied to the surface to be marked to ensure a wet film thickness of the applied epoxy, without glass beads, of 20 mils +/- 1 mil.
- F. Glass beads shall be applied as follows:
 - 1. At all markings except crosswalks:
 - a. Apply beads meeting the requirements of Grading "B" (larger beads) of Article M.7.30 shall be applied at a rate of 12 lb./gal. of epoxy pavement marking material,
 - b. Immediately follow first application by a second drop of glass beads meeting the requirements of Grading "A" (smaller beads) of Article M.7.30, applied at a rate of 13 lb./gal. of epoxy pavement marking material.

2. At crosswalks, only glass beads meeting the requirements of Grading "A" (smaller beads) shall be applied at a rate of 25 lb./gal. of epoxy pavement marking material.
- G. Perform all painting in a neat and workman-like manner so that lines are sharp and clear without feathered edging or fogging. Take precautions to prevent tracking by tires of the striping equipment. Apply paint as shown on the plans with no unsightly deviations.
 - H. After application, protect the paint from crossing vehicles for a time at least equivalent to the drying time of the paint.

****END OF SECTION 32 17 23****

SECTION 32 18 16

POURED-IN-PLACE PLAYGROUND SURFACING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Poured-in-Place Playground Surfacing System: "Super-7" as supplied by Surface America, Inc. · P.O Box 157 · Williamsville, NY 14231, Phone: (800) 999-0555, or approved equal.
- B. Related Sections:
 - 1. Section 31 00 00, Excavation, Backfill, Compaction and Dewatering
 - 2. Section 32 12 16, Bituminous Concrete Pavement
 - 3. Section 32 31 13, PVC Coated Chain Link Fencing
 - 4. Section 33 40 00, Storm Drainage

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
 - 2. ASTM D624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - 3. ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
 - 4. ASTM D2859 Standard Test Method for Flammability of Finished Textile Floor Covering Materials.
 - 5. ASTM E303 Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester.
 - 6. ASTM F1292 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment.
 - 7. ASTM F1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

1.3 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide a 2-layer rubber-urethane playground surfacing system which has been designed, manufactured and installed to meet the following criteria:
 - 1. Shock Attenuation (ASTMF1292):
 - a. Gmax: Less than 200.
 - b. Head Injury Criteria: Less than 1000.
 - 2. Flammability (ASTM D2859): Pass.
 - 3. Tensile Strength (ASTM D412): 60 psi (413 kPa).
 - 4. Tear Resistance (ASTM D624): 140%.
 - 5. Water Permeability: 0.4 gal/yd²/second.
 - 6. Accessibility: Comply with requirements of ASTM F1951.

1.4 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 product data and installation instructions.
- C. Verification Samples: Submit manufacturer's standard verification samples of 9" x 9" (229 x 229 mm) minimum.
- D. Quality Assurance/Control Submittals: Submit the following:
 - 1. Certificate of qualifications of the playground surfacing installer.
- E. Closeout Submittals: Submit the following:
 - 1. Warranty documents specified herein.

1.5 QUALITY ASSURANCE

- A. Qualifications: Utilize an installer approved and trained by the manufacturer of the playground surfacing system, having experience with other projects of the scope and scale of the work described in this section.
- B. Certifications: Certification by manufacturer that installer is an approved

applicator of the playground surfacing system.

- C. International Play Equipment Manufacturers Association (IPEMA) certified.

1.6 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 1 Product Requirement Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at a minimum temperature of 40 degrees F (4 degrees C) and a maximum temperature of 90 degrees F (32 degrees C).

1.7 PROJECT/SITE CONDITIONS

- A. Environmental Requirements: Install surfacing system when minimum ambient temperature is 40 degrees F (1 degree C) and maximum ambient temperature is 90 degrees F (32 degrees C). Do not install in steady or heavy rain.

1.8 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
 - 1. Warranty Period: Super-7: 7 years from date of completion of work.

PART 2 - PRODUCTS

2.1 POURED-IN-PLACE PLAYGROUND SURFACING SYSTEM

- A. Manufacturer: Surface America, Inc., or approved equal.
 - 1. Contact: PO Box 157, Williamsville, NY 14231; Telephone: (800) 999-0555, (716) 632-8413; Fax: (716) 632-8324; E-mail: info@surfaceamerica.com; website: <http://www.surfaceamerica.com>.
- B. Proprietary Products/Systems. Poured-in-place playground surfacing system, including the following:

1. Play Bound Poured-In-Place Primer:
 - a. Material: Urethane.
2. PlayBound Poured-in-Place Basemat:
 - a. Material: Blend of 100% recycled SBR (styrene butadiene rubber) and urethane.
 - b. Thickness – Refer to plans: [1 1/4" (31.75 mm) for 4' critical fall height] [2" (51 mm) for 5' critical fall height] [2 1/2" (64 mm) for 6' and 7' critical fall heights] [3" (76 mm) for 8' critical fall height] [3 1/2" (89 mm) for 9' critical fall height] [4" (102 mm) for 10' critical fall height] [5" (127 mm) for 12' critical fall height] [6" (152 mm) for 13' critical fall height].
 - c. Formulation Components: Blend of strand and granular material.
3. PlayBound Poured-In-Place Top Surface:
 - a. Material: Blend of recycled EPDM (ethylene propylene diene monomer) rubber and aromatic or aliphatic urethane binder.
 - b. Thickness: Nominal 1/2" (12.7 mm), minimum 3/8" (9.5 mm), maximum 5/8" (15.9 mm).
 - c. Color: Terra Cotta Red
 - d. Dry Static Coefficient of Friction (ASTM D2047): 1.0.
 - e. Wet Static Coefficient of Friction (ASTM D2047): 0.9.
 - f. Dry Skid Resistance (ASTM E303): 89.
 - g. Wet Skid Resistance (ASTM E303): 57.

2.2 PRODUCT SUBSTITUTIONS

- A. Substitutions: Substitutions must be submitted to the Owner for approval, with a table documenting compliance with these specifications.

2.3 MIXES

- A. Required mix proportions by weight:
 1. Basemat: 16+% urethane (as ratio: 14% urethane divided by 86%)

rubber). 14% urethane, 86% rubber (based on entire rubber & urethane mix).

2. Top Surface: 22% urethane (ratio: 18% urethane divided by 82% rubber). 18% urethane, 82% rubber (based on entire rubber & urethane mix).

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the playground surfacing manufacturer.

3.2 EXAMINATION

- A. Substrate preparation must be in accordance with surfacing manufacturer's specification. New asphalt must be fully cured - up to 30 days. New concrete must be fully cured - up to 7 days.
- B. Proper drainage is critical to the longevity of the PlayBound Poured-in-Place surfacing system. Inadequate drainage will cause premature breakdown of the poured system in affected areas; and void the warranty.

3.3 PREPARATION

- A. Surface Preparation: Using a brush or short nap roller, apply primer to the substrate perimeter and any adjacent vertical barriers such as playground equipment support legs, curbs or slabs that will contact the surfacing system at the rate of 300 sf ft/gal (7.5m²/L).

3.4 INSTALLATION

- A. Do not proceed with playground surfacing installation until all applicable site work, including substrate preparation, fencing, playground equipment installation and other relevant work, has been completed.
- B. Basemat Installation:
 1. Using screeds and hand trowels, install the basemat at a consistent density of 29 pounds, 1 ounce per cubic foot (466 kg/m³) to the specified thickness.
 2. Allow basemat to cure for sufficient time so that indentations are not left in the basemat from applicator foottraffic or equipment.
 3. Do not allow foot traffic or use of the basemat surface until it is sufficiently cured.

- C. Primer Application: Using a brush or short nap roller, apply primer to the basemat perimeter and any adjacent vertical barriers such as playground equipment support legs, curbs or slabs that will contact the surfacing system at the rate of 300 ft²/gal (7.5 m²/L).

- D. Top Surface Installation:
 - 1. Using a hand trowel, install top surface at a consistent density of 58 pounds, 9 ounces per cubic foot (938 kg/m³) to a nominal thickness of 1/2" (12.7 mm).
 - 2. Allow top surface to cure for a minimum of 48 hours.
 - 3. At the end of the minimum curing period, verify that the top surface is sufficiently dry and firm to allow foot traffic and use without damage to the surface.
 - 4. Do not allow foot traffic or use of the surface until it is sufficiently cured.

3.5 PROTECTION

- A. Protect the installed playground surface from damage resulting from subsequent construction activity on the site.

****END OF SECTION 32 18 16****

SECTION 32 30 00

MISCELLANEOUS SITE IMPROVEMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Project Manual, apply to the Work of this Section.

1.02 SUMMARY

- A. Furnish and install miscellaneous site improvements at locations indicated on the plans or as ordered and in conformance with the plans and these specifications:
 - 1. Double Swing Barrier Gate
 - 2. Painted Playground Markings
 - 3. Bollards
 - 4. Concrete Pads for Mechanical Equipment

1.03 REFERENCE STANDARD

- A. Connecticut Department of Transportation, "Standard Specifications for Roads, Bridges, and Incidental Construction", Form 817, 2016, and all revisions and addenda thereto.

1.04 SUBMITTALS

- A. Shop drawings for the following:
 - 1. Double Swing Barrier Gate
 - 2. Painted Playground Markings
 - a. Paint
 - b. Marking layout
 - c. Paint color samples

PART 2 - PRODUCTS

2.01 DOUBLE SWING BARRIER GATE

- A. Barrier gate shall be double-leafed, consisting of tubular shaped steel:
 - 1. Yield strength: 50,000 psi minimum.
 - 2. Conforming to ASTM F1043
 - 3. Conforming to Federal Specification RR-F-191/3, Class 1, Grade B.
- B. Steel shall be factory painted OSHA Safety Yellow, Federal Standard 595, Color FS 13591.
- C. Concrete for footings shall be Class "A" Concrete per CTDOT Form 817.
- D. Hardware to be coordinated with City of Stamford Facilities staff.

2.02 PAINTED PLAYGROUND MARKINGS

- 1. Paint shall be waterborne pavement marking paint per Article M.07.20 of CTODT Form 817.

2.03 BOLLARDS

- A. Pipe:
 - 1. 5" diameter nominal steel pipe, Schedule 40
 - 2. Filled with concrete.
- B. Finish:
 - 1. Subject to compliance with requirements provide paint products as manufactured by one of the following:
 - a. Tnemec Company, Inc.
6800 Corporate Drive
Kansas City, MO 64120
(816) 483-3400
 - b. Carboline Company
2150 Schuetz Road
Saint Louis, MO 63146
(800) 848-4645
 - c. Keeler and Long / PPG
856 Echo Lake Road
Watertown, CT 06795
(860) 274-6701

2. All finishes to be factory applied. Any nicks or scratches received during shipping shall be touched up in field following manufacturer's recommendations.
3. Provide complete multi-coat build-up finish of paint as recommended by manufacturer. Color to be selected by Architect.
4. Surface Preparation:
 - a. Surface to receive a light brush blast or hand-sanded finish.
 - b. After light brush blast or sanding, low pressure wash with Tnemec TSP detergent, or equivalent.
5. Primer:
 - a. After surface preparation, components shall be shop coated with Tnemec Series 27 Typoxy, or equivalent.
 - b. Follow complete manufacturer's instructions for application.
6. Color Coating:
 - a. After shop priming, all components shall be shop coated with Tnemec Endura Shield Series 73, or equivalent.
 - b. Follow complete manufacturer's instructions for application.
 - c. Color to be OSHA Safety Yellow, Federal Standard 595, Color FS 13591.
7. Finish Coat:
 - a. After color coating, all components shall be shop coated with Tnemec Endura Clear Series 76, or equivalent.
 - b. Follow complete manufacturer's instructions for application.

2.04 CONCRETE PAD FOR MECHANICAL EQUIPMENT

- A. Concrete shall be Class "F" conforming to Connecticut Department of Transportation Form 817, and all addenda and revisions thereto.

- B. Granular fill shall conform to the requirements of Article M.02.01 of Connecticut Department of Transportation Form 817, and all addenda and revisions thereto.
- C. Reinforcing shall conform to ASTM A615, Grade 60.

PART 3 - EXECUTION

3.01 CLEANING AND PROTECTION

- A. After installation, all surfaces shall be cleaned of deleterious mortar, paint, or other contaminants.
- B. Protect all work against damage until final acceptance.
- C. Damaged surfaces and other improvements shall be repaired or replaced as directed at no additional cost to the Owner.

3.02 DOUBLE SWING BARRIER GATE

- A. Auger hole for concrete base to lines and depth shown on plans.
- B. Form concrete base and install posts.
- C. Place concrete in base and install posts plumb.
- D. Allow concrete to cure.
- E. Install gates and hardware.

3.03 PAINTED PLAYGROUND MARKINGS

- A. Pavement areas to be painted shall be dry and sufficiently cleaned of sand and debris so as to provide an acceptable bond between the paint and the pavement.
- B. Paint shall be applied at a rate of 100 to 115 s.f./gal., no glass beads.
- C. All painting shall be performed in a neat and workmanlike manner. The lines shall be sharp and clear with no feathered edging or fogging, and precautions shall be taken to prevent tracking.
- D. Paint shall be applied with no unsightly deviations.
- E. After application, the paint shall be protected for a time at least equivalent to the drying time of the paint.

3.04 BOLLARDS

- A. Auger hole for concrete base to lines and depth shown on plans.

- B. Form concrete base and install rebar and bollard.
- C. Place concrete in base and inside bollard.
- D. After concrete has cured, round top of dome as shown on Drawings.

3.05 CONCRETE PADS FOR MECHANICAL EQUIPMENT

- A. Confirm dimensions and locations of pads with mechanical and electrical trades as may be appropriate.
- B. Excavate pad area to lines and dimensions shown on plans, and prepare subgrade.
- C. Place granular fill in single lift, and compact to 95% density.
- D. Place forms for concrete work in accordance with Section 03 00 00.
- E. Place concrete in accordance with Section 03 00 00.
- F. Allow pads to cure before setting equipment upon them.

****END OF SECTION 32 30 00****

SECTION 32 31 13

PVC COATED CHAIN LINK FENCE

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Project Manual, apply to the Work of this Section.

1.02 SUMMARY

- A. Install Polyvinyl Chloride (PVC) coated chain link fabric with PVC color coated galvanized steel framework and accessories in the locations identified on the plans.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 31 25 00 – Sediment and Erosion Control

1.03 COORDINATION

- A. Coordinate and schedule the work of this Section with all trades involved to prevent interference, and in order to allow adequate time at the proper stage of construction to properly perform all work of this Section.
- B. Coordinate the work of this Section with the Owner to minimize impact upon facility operation.

1.04 REQUIREMENTS AND RESTRICTIONS

- A. Take proper precautions not to damage any existing site conditions and take responsibility for any damage occurring during the course of the work under construction.
- B. Perform all repairs as required to restore any area or item so damaged to its original condition at no additional expense to the Owner.

1.05 REFERENCES

- A. ASTM A36 Standard Specification for Carbon Structural Steel
- B. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-dip Galvanized Coatings

- C. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Bars, Rods, Wire Profiles and Tubes
- D. ASTM F552 Standard Terminology Relating to Chain Link Fencing
- E. ASTM F567 Standard Practice for Installation of Chain Link Fence
- F. ASTM F626 Standard Specification for Fence Fittings
- G. ASTM F668 Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain Link Fence Fabric
- H. ASTM F934 Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials
- I. ASTM F1043 Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework
- J. ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
- K. ASTM F1664 Standard Specification for Polyvinyl Chloride (PVC) and Other Conforming Organic Polymer-Coated Steel Tension Wire Used With Chain Link Fence

1.06 SUBMITTALS

- A. Shop drawings: Layout of fences and gates with dimensions, details, and finishes of components, accessories, and post foundations.
- B. Product data: Manufacturer's catalog cuts indicating material compliance and specified options.
- C. Samples: If requested, samples of materials (e.g., fabric, wires, color, and accessories).

1.07 QUALITY ASSURANCE

- A. Manufacturer: Company having manufacturing facilities in the United States with 5 years experience specializing in manufacturing of chain link fence products.
- B. Fence contractor: Contractor having 5 years experience installing similar projects in accordance with ASTM F567.
- C. Tolerances: ASTM current specification and tolerances apply and supersede any conflicting tolerance.
- D. Single source: To ensure system integrity obtain the chain link system, framework, fabric, fittings, gates and accessories from a single source.

PART 2 - PRODUCTS

2.01 CHAIN LINK FENCE FABRIC

- A. Polyvinyl Chloride (PVC) color coated steel chain link fabric per ASTM F668, Class 2A.
- B. Physical properties:
 - 1. 2-inch mesh
 - 2. 9 gauge, steel core wire having a break load of 1,290 lbf
- C. Selvage of fabric knuckled at top and bottom.
- D. Color of chain link fabric per ASTM F934, black.

2.02 PVC COLOR COATED STEEL FENCE FRAMEWORK

- A. Color to match chain link fabric.
- B. Steel pipe:
 - 1. Cold formed electric resistance welded steel pipe complying with ASTM F1043 Group IC having minimum steel yield strength of 50,000 psi.
 - 2. External protective coating F1043 Type B, 0.9 oz/ft² minimum hot-dip zinc coating plus a chromate conversion and a clear polymer coating, plus a minimum 10 mil thermally fused PVC color coating in accordance with F1043.
 - 3. Internal coating F1043 Type D, 81% nominal zinc pigmented coating minimum 3 mils thick or Type B, minimum 0.9 oz/ft² zinc.
 - 4. Dimensions
 - a. Pipe End and Corner Post
 - (1) Outside diameter, 2-3/8 inches
 - (2) Weight, 3.12 lb/ft.
 - b. Pipe Line Post
 - (1) Outside diameter, 1-7/8 inches
 - (2) Weight, 2.28 lb/ft

c. Pipe Rail and Braces

- (1) Outside diameter, 1-5/8 inches
- (2) Weight, 1.84 lb/ft

2.03 FITTINGS

- A. All fittings to be PVC thermally fused color coated having a minimum thickness of 0.006 inches per ASTM F626. PVC color to match fabric and framework. Moveable parts, nuts, and bolts to be field coated with PVC liquid touch up after installation.
- B. Post caps
 1. ASTM F626 galvanized pressed steel, malleable iron, or aluminum alloy weather tight closure cap for tubular posts.
 2. Provide one cap for each post. Provide line post loop tops to secure top rail.
- C. Rail ends
 1. Galvanized pressed steel per ASTM F626, for connection of rails to post using a brace band.
- D. Top rail sleeves
 1. 7 inch galvanized steel sleeve per ASTM F626.
- E. Wire ties
 1. 9 gauge (0.148") galvanized steel wire for attachment of fabric to line posts and rails.
 2. Pre-formed hog ring ties to be 9 gauge (0.148") galvanized steel or aluminum for attachment of fabric to tension wire.
 3. Tie wire and hog rings PVC coated and in compliance with ASTM F626. Color to match fabric color.
- F. Brace and tension (stretcher bar) bands
 1. ASTM F626 galvanized 12 gauge (0.105") pressed steel by 3/4" formed to a minimum 300 degree profile curvature for post attachment.
 2. Secure bands using minimum 5/16" galvanized carriage bolt and nut.
- G. Tension (stretcher) galvanized steel bars

1. One piece lengths equal to 2 inches less than full height of fabric with a minimum cross-section of 3/16" x 3/4" per ASTM F626.
 2. Provide tension (stretcher) bars where chain link fabric is secured to the terminal post.
- H. Truss rod assembly
1. Galvanized steel minimum 5/16" diameter truss rod with pressed steel tightener, in accordance with ASTM F626
- I. Carriage bolts and nuts
1. Galvanized of commercial quality

2.04 TENSION WIRE

- A. Polyvinyl Chloride (PVC) coated metallic coated steel tension wire per ASTM F 1664
- B. 7 gauge steel core wire, 0.177"
- C. PVC coating class and color to match chain link fabric

2.05 POST SETTING MATERIALS

- A. Concrete
 1. Class "A" concrete conforming to CTDOT Form 817.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Ensure property lines and legal boundaries of work are clearly established.
- B. Survey of fence location to be provided by Contractor.
- C. Verify areas to receive fencing are completed to final grade.

3.02 CHAIN LINK FRAMEWORK INSTALLATION

- A. Install chain link fence system in accordance with ASTM F567 and manufacturer's instructions.
- B. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30° or more.

- C. Space line posts uniformly with a maximum 10 foot spacing on center.
- D. Concrete set corner, terminal and pull posts:
 - 1. Dig holes in firm, undisturbed or compacted soil.
 - 2. Holes shall have diameter as shown on the plans
 - 3. Depth of hole approximately 6" deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads.
 - 4. Set post bottom 36" below surface when in firm, undisturbed soil.
 - 5. Place concrete around posts in a continuous pour.
 - 6. Trowel finish around post and slope to direct water away from posts.
- E. Drive Anchor set line posts:
 - 1. With protective cap, drive post 36" into ground.
 - 2. Excavate a 6" diameter by 6" deep section around post to accommodate the drive anchor shoe clamp.
 - 3. Drive the 2 diagonal drive anchor angle blades into the soil and securely tighten the angle blades to the post using the shoe clamp, bury the shoe clamp.
- F. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
- G. Bracing
 - 1. Install horizontal brace and truss assembly at each fabric connection to the terminal post.
 - 2. The diagonal truss rod is installed at the point where the brace rail is attached to the terminal post and diagonally down to the bottom of the adjacent line post..
 - 3. Place the truss rod in tension by adjusting the turnbuckle.
- H. Tension wire
 - 1. Install tension wires so that they will be located 4" up from bottom the fabric.

2. Stretch and install tension wire before installing the chain link fabric and attach it to each post using wire ties.
- I. Top rail
 1. Connect ends with sleeves forming a rigid connection, allow for expansion and contraction.
 - J. Touch up any nicks or scratches of the PVC color coating with liquid PVC paint.

****END OF SECTION 32 31 13****

SECTION 32 90 00

LANDSCAPING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Project Manual, apply to the Work of this Section.

1.02 SUMMARY

- A. Section includes:
 - 1. Planting of trees, shrubs and bushes.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 31 25 00 – Sediment and Erosion Control
 - 2. Section 32 90 03 – Lawns and Grasses

1.03 REFERENCES

- A. Connecticut Department of Transportation, “Standard Specifications for Roads, Bridges, and Incidental Construction”, Form 817, as amended.
- B. American Association of Nurserymen (AAN) Specifications.

1.04 SUBMITTALS

- A. Planting Soil Analysis: Furnish a planting soil analysis prepared by a commercial or government agency approved by the Engineer to show that all amendments necessary for good plant growth have been added.
- B. Bark Mulch: Furnish one cubic foot with name and address of the supplier.
- C. Instructions to the Owner: Furnish complete written instructions for maintenance of the plant materials to the Owner at least ten days prior to the end of the maintenance period in order to familiarize the Owner with the proper care and development of the plantings.
- D. Furnish certifications from plant suppliers indicating the botanical name, quantity, and size of plants to be delivered to the project.

- E. Inspection and Acceptance: Submit inspection notice and planting plan as required herein.

1.05 QUALITY ASSURANCE

- A. Perform Work with experienced personnel under the direction of a skilled foreman with a minimum of three years experience with similar type and size projects.
- B. Plants are subject to inspection and approval by the Engineer before delivery for conformity to Specification requirements as to quality, size and variety.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Only deliver plant materials immediately prior to installation.
- B. Deliver plant materials to the site in accordance with the best horticultural practices to prevent damage.
- C. Move and handle plant materials so as to prevent damage to roots and crowns.
- D. "Heal-in" plants that cannot immediately be installed with bark mulch or wood chips in a location that protects the plants from sun and wind. Rootballs and containers shall be completely covered and kept consistently moist until installation.
- E. Replace damaged and unhealthy plant materials prior to installation as directed by the Engineer.

1.07 WARRANTY

- A. Plants shall be true to botanical name and size, and in vigorous healthy growing condition.
- B. Plants shall be guaranteed for 1 year from date of original or replacement installation.

PART 2 – PRODUCTS

2.01 PLANT MATERIALS

- A. Plant material requirements:
 - 1. Nursery grown, conforming to the American Association of Nurserymen Standards.
 - 2. Hardy under climatic conditions similar to those in the locality of the project.

3. Typical of their species or variety, with a normal habit of growth.
4. Sound, healthy and vigorous.
5. Well branched and densely foliated when in leaf.
6. Free of disease, insect pests, eggs or larvae, and with healthy, well-developed root systems.
7. Substitutions shall be permitted only upon written approval of the Engineer.
8. Dimensions shall conform to specifications in the current edition of Horticultural Standards of the American Association of Nurserymen.
9. Types and sizes of deciduous and evergreen plants for this project shall be as shown on the project drawings

2.02 MISCELLANEOUS MATERIALS

- A. Planting soil shall be prepared based on the following proportions.
 1. One part dehydrated sterilized manure.
 2. One part peat moss.
 3. Three parts vegetative support material with a pH of 6.0 to 6.5.
- B. The following amendments shall be incorporated into the prepared planting soil prior to backfilling of planting pits in accordance with the planting soil analysis.
 1. Fertilizer: Complete with 70% of the nitrogen derived from organic sources.
 2. Lime: Ground dolomite limestone; 95% passing through a 100-mesh sieve.
 3. Super Phosphate: Finely ground phosphate rock as commonly used for agricultural purposes containing not less than 18% available phosphoric acid.
 4. Bone Meal: Commercial raw bone meal, finely ground, minimum analysis of 1% nitrogen and 18% phosphoric acid.
 5. Peat Moss: Shall be domestic brown sphagnum peat; natural, shredded or granulated with a pH of 4.0 to 5.0; low in woody material content; free from mineral matter such as sulfuric and iron harmful to plant life; water absorbing capacity of 1100% to 2000%; and moisture content of 30%.

6. Anti-Desiccant shall be "Wilt-Pruf" or equal approved by Engineer, delivered in manufacturer's containers and used according to manufacturer's instruction.
- C. Bark Mulch shall be 100% fine shredded pine or hardwood bark, free of foreign matter size ranging from ¼ inch to 2 inch.

PART 3 - EXECUTION

3.01 PLANTINGS

- A. Plant trees and shrubs in pits 12 inches greater in width than the diameter of the root ball.
- B. Pit depth shall be sufficient to ensure a minimum of 6 inches of planting soil mixture under plant root system.
- C. Set plants in center of pits, plumb and straight and at level that top of root ball is 1 inch lower than surrounding finished grade after settlement.
- D. Compact topsoil mixture thoroughly around base of root ball to fill all voids, when plant material is set.
- E. Cut all burlap and lacing and remove from top of root ball. Do not pull burlap from under any root ball.
- F. Backfill pits halfway with planting soil mixture and thoroughly puddle before backfilling pit.
- G. Water planting, again, when each backfill operation is complete.
- H. Thoroughly compact topsoil planting mixture around root balls and water.
- I. Immediately after plant pit is backfilled, form a shallow saucer slightly larger than pit with ridge of soil to facilitate and contain watering.
- J. Grub out sod or other growth and remove from bed area. Rake bed area smooth and neat.
- K. Pine bark mulch is to be placed in a 3 inch thickness around the planting. The area to be mulched shall be circular with a diameter of 12 inches greater than the plantings root ball.
- L. Mulch is to be contained around the circumference of the planting by means of installing a metal edge strip. Metal edge strips shall be fastened securely in place with tapered metal stakes at 30 inch intervals along the strip. Set edge strips to finished grade.
- M. All plantings 10 feet or higher shall be supported by a minimum of 2 wooden

stakes driven into the ground within the mulch area. Guide wires with garden hose protection shall be attached.

- N. Prune each shrub in accordance with American Association of Nurserymen standards to preserve natural form and character of plant. All pruning is to be done with clean, sharp tools and carried out only by workmen thoroughly familiar with this type of work.
- O. Apply antidessicant to all evergreen trees and shrubs and to all deciduous plant materials which are leafed out at time of planting. Rate and method of application in accordance with manufacturer's recommendations.
- P. All plantings shall be in accordance with American Association of Nurserymen standards.

3.02 TIME OF PLANTING

- A. The time of planting shall be guided by the schedule below unless otherwise approved by the Engineer based on plant types, weather conditions or other factors that may be detrimental to plant growth.

Material Type	Spring	Fall
Deciduous	March 15 th to June 1 st	October 15 th to November 1 st
Evergreen	March 15 th to June 1 st	August 15 th to October 1 st

3.03 EXISTING CONDITIONS

- A. Refer to Drawings showing finish grades. No installation of plants shall take place until all subgrade elevations have been completed.
- B. Prior to planting, verify locations and depth of underground utilities. Exercise care when digging in these areas. Assume responsibility for any damage and replace or repair any damage at the Contractor's expense to the satisfaction of the Engineer.

3.04 FIELD MEASUREMENTS

- A. Make all necessary measurements to properly locate the plants as shown on the Drawings.
- B. Location and arrangement of plants shall be approved by the Engineer prior to installation.
- C. Plants installed prior to approval by the Engineer shall be relocated, if necessary, at no additional cost to the Owner.

3.05 PLANTING PITS

- A. Excavate to the depths and widths necessary to achieve the dimensions

indicated on the Drawings.

- B. Excavated soil and material may be used as a portion of the backfill and planting soil provided it meets the requirements of this Section.

3.06 INSTALLING DECIDUOUS AND EVERGREEN PLANTS

- A. Place sand or stone drainage layer in the bottom of the pit if required due to wet conditions.
- B. Place prepared planting soil and tamp firmly until the required depth is achieved.
- C. Place the plant in the center of the pit or spaced in beds as indicated on the Drawings.
- D. Set the plant plumb and adjust its height to achieve the elevation shown on the Drawings by placing prepared planting soil beneath the rootball.
- E. Cut burlap, rope, wires or other material and remove from the top 1/2 of the rootball and do not leave in the planting pit.
- F. Backfill around the rootball with prepared planting soil. Uniformly compact and water the prepared planting soil to fill all voids and to firmly secure the rootball.
- G. Form a shallow "saucer" at the surface of the planting pit or bed with topsoil. Blend the perimeter of the saucers and beds to form a smooth and uniform transition to the finish grade.
- H. Immediately after planting neatly spiral wrap tree trunks from the bottom to the height of the second set of branches. Secure wrapping using suitable methods.

3.07 MULCHING DECIDUOUS AND EVERGREEN PLANTS

- A. Cover all tree pits and shrub beds with bark mulch. Neatly outline the edges of the saucer at a uniform radius from the tree trunk.

3.08 PRUNING

- A. Prune plants in accordance with American Association of Nurserymen Standards to preserve the natural character of the plant.
- B. Remove all dead wood or suckers and all broken or badly bruised branches. Paint cuts over 1 inch in diameter with a tree paint especially manufactured for this purpose.
- C. Cover all exposed cambium as well as other exposed living tissue.

3.09 PLANT MAINTENANCE

- A. Begin maintenance immediately after planting and continue for 1 year from date all plantings have been installed. Plantings done in late fall after November 1st shall be maintained until the second spring leafing.
- B. Continue the maintenance period at no additional cost to the Owner until all previously noted deficiencies have been corrected, at which time the final inspection will be made.
- C. All plant materials shall be watered, fertilized, pruned, weeded, and sprayed as required to keep plant material in a healthy growing condition, and to keep planted areas neat and attractive.
- D. Provide all equipment and means for proper application of water to plants.
- E. Fertilize plants in spring and fall.
- F. Protect all planted areas against damage, including erosion and trespassing by providing and maintaining proper safeguards.
- G. Reset settled plants to proper grade and position.

3.10 REPLACEMENT OF DECIDUOUS AND EVERGREEN PLANTS

- A. Dead or declining plant material shall be removed immediately and replaced as soon as possible with a new, healthy plant of the same type and size as specified, at no additional cost to the Owner.
- B. Replacement plants shall be maintained and guaranteed for 1 year from time of replacement.
- C. All plant material required under this contract, deemed by the Engineer to be unsightly, unhealthy, or excessively pruned, during and at the end of the guarantee period, shall be replaced as soon as conditions permit.
- D. At the end of the maintenance period all plant material shall be in a healthy growing condition.

3.11 INSPECTION AND ACCEPTANCE

- A. The Engineer shall be the sole judge of acceptance.
- B. All materials and workmanship will be subject to inspection and examination by the Engineer, and he/she shall have the right to reject defective materials and workmanship or require corrections.
- C. Submit written notice requesting inspection by the Engineer at least 10 days prior to the end of the maintenance period.
- D. Submit planting plans indicating the dates plants were installed for purposes of

establishing warranty and replacement dates.

****END OF SECTION 32 90 00****

SECTION 32 90 03
LAWNS AND GRASSES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Restoration of all vegetated areas disturbed during construction
 - 2. New loam and seed areas
 - 3. Temporary seeded areas
- B. Related Sections
 - 1. Section 31 10 10 – Site Preparation

1.02 REFERENCES

- A. ASTM D5539 – Standard Specification for Seed Starter Mix

1.03 QUALITY ASSURANCE

- A. Seed shall be placed only between the periods from April 15th to June 1st, and from August 15th to October 1st, unless otherwise approved by the Engineer.

1.04 SUBMITTALS

- A. Submit the following for approval:
 - 1. Lawn seed mixture including percent by weight of each seed type, and manufacturer/supplier name.
 - 2. Manufacturer's/supplier's descriptive literature for seed and hydromulch.
 - 3. Suitable laboratory analysis of the soil to determine the quantity of fertilizer and lime to be applied.
 - 4. Lime and starter fertilizer application rates based on laboratory soil tests.
 - 5. Seed tags: After applying seed to all areas, retain and submit all seed bags to the Landscape Architect.

1.05 DELIVERY AND STORAGE

- A. Adequately protect all products from moisture during delivery and storage.
- B. Deliver soil amendments, seed and hydromulch that is dry and free flowing, in original containers, each bearing the manufacturer's guaranteed analysis,

conforming to applicable state laws. Any product which becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted.

1.06 JOB CONDITIONS

- A. Supply and distribute all water required to sustain vegetation at no additional cost to the Owner.
- B. Improper work and/or materials to be corrected whenever discovered.
- C. Upon completion of all seeding, remove and dispose of all materials, stones and debris resulting from work operations of this Section. Legally dispose of all materials and debris to designated on-site fill areas approved by the Owner. Restore to original conditions all damaged pavements, structures or any other items resulting from installation operations of this Section.

1.07 REVIEW AND ACCEPTANCE

- A. Upon completion of all seeded areas, review of the seeded areas will be made upon written request of such review by the Contractor, when submitted at least ten (10) days before the anticipated date of review.
- B. Issue the request, in no case earlier than six (6) weeks, after the installation of all temporary seeded areas.
- C. Inspection and acceptance may be requested and granted in part, provided the areas for which acceptance is requested are substantial in size with clearly defined boundaries.
- D. Establish a dense growth of permanent grasses. Any part of the seeded areas that fails to show a uniform stand of grass is to be reseeded and re-mulched as originally specified in this Section.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Loam
 - 1. Loam shall consist of fertile, friable, natural topsoil typical of the locality without admixture of subsoil, refuse or other foreign materials and shall be obtained from a well-drained arable site. It shall be such a mixture of sand, silt and clay particles as to exhibit sandy and clayey properties in and about equal proportions. It shall be reasonably free of stumps, roots, heavy or stiff clay, stones larger than 1-inch in diameter, lumps, coarse sand, noxious weeds, sticks, brush or other litter. Topsoil as delivered to the site or stockpiled shall have pH between 6.0 and 7.0 and shall contain not less than 5 percent or more than 8 percent organic matter as determined by loss of ignition of moisture-free samples dried at 100

degrees Celsius. The topsoil shall meet the following mechanical analysis:

OPENING SIZE	PERCENTAGE FINER
1-in screen opening	100
No. 10 mesh	95 to 100
No. 270 mesh	35 to 75
0.002 mm*	5 to 25

* Clay size fraction determined by pipette or hydrometer analysis.

B. Starter Fertilizer

1. Commercial grade fertilizer with an approximate 1-2-1 ratio. Elements may be organic, inorganic or a combination and shall be available according to the methods adopted by the Association of Agricultural Chemists. Deliver the fertilizer in standard-sized, sealed bags of the manufacturer accompanied by the manufacturer's guarantee.

C. Lime

1. Ground dolomitic agricultural limestone conforming to ASTM C 602, Class T. At least seventy-five percent (75%) shall pass a #20 mesh sieve with total calcium carbonates not less than eighty percent (80%).

D. Lawn Seed

1. Seed shall be of the previous year's crop.
2. Required ranges:
 - a. Purity > 90%
 - b. Germination > 80%
 - c. Crop < 0.5%
 - d. Weed < 0.3%
 - e. Noxious Weed – 0%
 - f. Inert < 8%
3. The standard seed mixture shall be applied at a minimum rate of 175 lbs./acre, 4 lbs./1,000 sf.
4. Grass seed shall conform to the following mixture in proportion by weight and weed content and shall pass the minimum percentages of purity and germination as indicated for same.

LAWN AREA SEED MIX	% WEIGHT
"Rebel II" Tall Fescue	70%
"Baron" Kentucky Bluegrass	10%
"Palmer" Perennial Ryegrass	20%

5. All seed shall comply with State and Federal seed laws.
 6. A sworn certificate indicating each variety of seed, weed content, germination of seed, net weight, date of shipment and manufacturer's name shall accompany each seed shipment. Regardless of approval by the Engineer to sow the seed, complete responsibility for satisfactory results shall rest entirely on the Contractor.
- E. Temporary Seed
1. Fresh, viable, recleaned, pure, quality seed of the latest crop, delivered in original, unopened packages, bearing guaranteed analysis tags, name of seed supplier and date of packaging.
 2. Seed mixture to be a blend of 90% perennial rye grass and 10% Chewings Fescue, by volume.
- F. Hydromulch
1. Silva Fiber Plus, 100% virgin wood fiber mulch with 3% premused tackifier as manufactured by Weyerhaeuser Company.

PART 3 EXECUTION

3.01 PREPARATION

- A. The ground surface shall be fine graded and raked so as to prepare the surface of the loam for lime, fertilizer and seed.
- B. The Contractor shall perform a laboratory soil test on the proposed loam before placing any lime, fertilizer, or seed. This work shall be in accordance with ASTM D5539.

3.02 LAWN AREAS

- A. Fertilizer and lime shall be applied to the surface of the ground in accordance with the manufacturers' instructions, and based on the results of the certified soils test.
- B. The seed shall then be placed using a drop or rotary spreader at the rate recommended by the seed manufacturer for the intended use of the lawn or grass area being restored.

- C. After spreading of the seed, lightly rake the surface to work the seed in. The surface shall then be rolled.
- D. All seed on banks and slopes of three to one (3:1) and greater will be staked.

3.03 HYDRO-SEEDING AND MULCHING

- A. Before any seed is sown, the topsoil is to be raked until the surface is smooth and friable. Seed by means of an approved mechanical agitation hydro-seeder.
- B. Mix specified seed, starter fertilizer and wood fiber mulch (with tackifier) as a slurry, using approved hydroseeding equipment. Continue mixing until uniformly blended into a homogeneous slurry suitable for hydraulic application.
- C. Apply slurry (with seed, fertilizer and mulch) uniformly to all seeded areas in a one-step process.
- D. Apply wood fiber mulch at a minimum rate of one thousand five hundred (1,500) pounds per acre (35 pounds per 1000 square feet) dry weight together with a seeding rate of three hundred fifty (350) pounds per acre (eight (8) pounds per 1000 square feet) and starter fertilizer at a rate equal to one pound of nitrogen per 1000 square feet.
- E. Do not apply slurry to building or pavement surfaces or trees. Over spray is to be removed by the Contractor and affected areas repaired to their original state.
- F. Execute seeding whenever weather and soil conditions are favorable and when wind does not exceed a velocity of five miles per hour (5 mph). Recommended time of seeding is April 1 to May 31 and September 1 to October 15. However, time of seeding is at the Contractor's discretion.
- G. Keep seeded areas uniformly moist to a depth of four inches (4") at all times until germination. Water, as many times as necessary thereafter, to provide acceptable seeded areas.

3.04 MAINTENANCE

- A. The responsibility for satisfactory results on work carried out under this item rests entirely on the Contractor, regardless of the prior approval of the materials and methods on the part of the Engineer.
- B. Maintain loamed and seeded areas by mulching, covering, netting, watering, fencing, etc., until an acceptable stand of vegetation is approved by the Engineer.
- C. The dressed and seeded areas shall be carefully and suitably sprinkled with water as necessary from time to time. Suitable signs and barricades should be placed to protect the seeded areas. After the grass has started to grow, all areas and parts of areas that fail to show a uniform stand of grass for any reason whatsoever, shall be seeded repeatedly until all areas are covered with a satisfactory growth of grass.

- D. Suitable signs and barricades should be placed to protect the seeded areas. After the grass has started all areas and parts of areas that fail to show a uniform stand of grass for any reason whatsoever, shall be reseeded until all areas are covered with a satisfactory growth of grass.

3.05 SPECIAL CONSIDERATIONS

- A. Following the final top course of paving all pavement edges, waterways, sidewalks, berms, etc. shall be brought to grade with loam, fine graded, raked, seeded, and rolled to the satisfaction of the Engineer. Whenever possible the final surface of the loam backup shall slope away from the surface edge to allow proper sheeting of runoff. The Contractor shall be solely responsible for protecting, maintaining, and repairing this work until a satisfactory start of healthy grass is established.
- B. Upon removal of the haybales and siltation fence, the Contractor shall loam and seed all disturbed areas.
- C. In locations where the project area passes through existing grass, weed brush or tree-surfaced areas that are not covered by a specific lawn repair item, surface restoration shall be as follows:
 - 1. After completion of backfilling, the existing loam and surface materials, which were salvaged during excavation, shall be returned to the top of the trench.
 - 2. After natural settlement and compaction has taken place, the trench surface shall be harrowed, dragged and raked as necessary to produce a smooth and level surface.
 - 3. The area is then to be sowed with "orchard grass" or "rye grass" or other such materials to hold the soil and produce a growth similar to that existing prior to construction.

3.06 GUARANTEE PERIOD AND FINAL ACCEPTANCE

- A. All seeded areas shall be guaranteed for not less than 1 full year from the time of final acceptance.
- B. At the end of the guaranteed period, inspection will be made by the Engineer upon written request submitted at least 10 days before the anticipated date. Seeded areas not demonstrating satisfactory stands as outlined above, as determined by the Engineer, shall be renovated, reseeded and maintained meeting all requirements as specified herein.
- C. After all necessary corrective work has been completed, the Engineer shall certify in writing the final acceptance of the seeded areas.

****END OF SECTION 32 90 03****

SECTION 33 05 14

CONNECTION TO EXISTING CATCH BASINS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Project Manual, apply to the Work of this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Breaking through the walls of existing catch basins.
 - 2. Connecting new pipes to existing structures.
 - 3. Ancillary work associated with making the new connections to the existing structures.

1.03 REFERENCES

- A. ASTM C443 – Standard Specification for Joints for Circular Concrete Sewer and Culvert Piping Using Rubber Gaskets.
- B. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.04 SUBMITTALS

- A. Submit shop drawings showing pipe connection details.

1.05 QUALITY ASSURANCE

- A. Personnel shall have confined space entry training as appropriate for the work to be performed.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Non-shrink, water-proof grout
 - 1. Non-shrink, water-proof grout shall be Hallemite; Waterplug; Embecco; or equal.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General

1. Core drill into existing structures in such a fashion as to make an opening of suitable size to accommodate the connecting pipe without excessive damage to the existing structure.

B. Pipe Connections

1. Rebuild and tightly close existing catch basin walls to provide an integral, water-tight structure around the new pipes.

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****END OF SECTION 33 05 14****

SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and other Division 01 Specifications, apply to this section.

1.02 SUMMARY

- A. The Contractor shall furnish all materials, labor and equipment to complete work related to installation of new underground water and fire lines.
- B. Section includes providing all labor, materials, equipment and incidentals required to install ductile iron pipe and fittings as shown on the Drawings and as specified herein.
- C. Furnish all labor, materials, equipment and incidentals required to install any extra fittings, specials, shorts, etc., that are not shown on the Drawings or as specified herein, but are required as a result of unexpected subsurface conditions or utility locations.

1.03 REFERENCES

- A. All pipe and fittings shall conform to the latest edition of the following specifications unless otherwise specified herein and shall be MANUFACTURED on the North American Continent.
 - 1. ANSI Standard Specification A21.51 (AWWA-C151) for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Models for Water and Other Liquids.
 - 2. ANSI Standard Specification A21.50 (AWWA-C150) for the Thickness Design of Ductile Iron Pipe.
 - 3. ANSI Standard Specification A21.53 (AWWA-C153) for Compact Design, 350 psi, Ductile Iron Fittings for Water.
 - 4. ANSI Standard Specification A21.10 (AWWA-C110) for Ductile Iron and Grey Iron Fittings 3" through 48" for Water and Other Liquids.
 - 5. ANSI Standard Specification A21.11 (AWWA-C111) for Rubber-Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings.

6. ANSI Standard Specification A21.15 (AWWA-C115) for Flanged Ductile Iron Pipe with Threaded Flanges.
 7. ANSI Standard Specification 21.4 (C104) Cement Mortar Lining for Ductile Iron Pipe and Fittings.
- B. Aquarion Water Company specifications and water service requirements.
- C. City of Stamford specifications and requirements.

1.04 SUBMITTALS

- A. Submit to the Engineer, material specifications and shop drawings for all materials and equipment furnished under this Section.
- B. Provide Certificates of Compliance on pipe materials.
- C. All manufacturers of pipe on the project shall have an established, annually audited and certified, quality control procedure for manufacturing of pipe. Each manufacturer shall be certified by an independent, third party auditor for compliance with all requirements of the AWWA standards. The manufacturer shall submit a current certificate of compliance for the plant facility where the pipe is to be made. Certificate of compliance shall be submitted for each additional year of pipe manufacturing during the duration of the Project. The manufacturer shall not change the plant manufacturing the pipe during the duration of the Project without the written authorization of the Engineer.

1.05 QUALITY ASSURANCE

- A. The Contractor shall provide test pits as shown on the Drawings, as required by the Engineer, or as required to fully investigate and determine line and grade obstructions for utility services.
- B. The Contractor shall secure all permits and pay all fees required to carry out the piping work. He shall comply with all laws, ordinances, codes, rules, and regulations of the local and state authorities having jurisdiction over any of the work specified herein. Where provisions of the Contract are in conflict with the codes, the code shall govern requirements set forth in this Section and indicated on the Drawings. The Contract Documents shall govern when in excess of the required or minimum regulations.
- C. All ductile iron pipe shall be from a single manufacturer. All fittings shall be from a single manufacturer, not necessarily the pipe manufacturer.
- D. Prior to first shipment of pipe, submit certified test reports that the pipe for this Contract was manufactured and tested in accordance with the ASTM and ANSI/AWWA Standards specified herein.
 1. Shop Inspection - All materials furnished by the Contractor are subject, at the discretion of the Engineer, to inspection and approval at the plant of

the manufacturer. Except where specified otherwise, all inspection will be carried out by the Engineer and will be carried out at no direct expense to the Contractor.

2. Inspection of the pipe and fittings will be made by the Engineer after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the job site at no additional cost to the Owner.
3. All pipe shall be laid, jointed and tested under pressure for defects and leakage in the manner hereinafter specified. All construction operations are to be carried out in the presence of, and subject to, the approval of the Engineer.
4. Disposition of Defective Material - All material found during the progress of the Work to have cracks, flaws or other defects will be rejected by the Engineer. All defective materials furnished by the Contractor shall be promptly removed by him from the site, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. U.S. Pipe
- B. Griffin Pipe Products
- C. American Cast Iron Pipe Company
- D. or Approved Equal.

2.02 MATERIALS

- A. All direct buried pipe shall be class 52 ductile iron pipe, push-on-joint conforming to AWWA C151.
- B. Fittings shall be ductile iron or gray iron. Pipe fittings for below ground service shall be mechanical joint, unless noted otherwise on the Drawings.
 1. Fittings $\leq 12''$ in size shall conform to ANSI A21.10 (AWWA C110) or ANSI A21.53 (AWWA C153) and shall have a 350 psi pressure rating.
 2. Fittings $>12''$ in size shall conform to ANSI A21.10 (AWWA C110) and shall have the following pressure ratings:
 - a. Fittings $>12''$ and $\leq 24''$ - 350 psi

- b. Fittings >24" - 250 psi

- C. Mechanical joint and push-on joint ductile iron pipe and fitting joints shall be utilized for buried pipe and shall conform to ANSI/AWWA A21.11/C111 as applicable.

- D. All pipe and fittings, except where specified, shall have a bituminous outside coating in accordance with AWWA C151 and C110 or C153, respectively. All pipe and fittings shall be cement-mortar lined and seal coated on the interior in accordance with AWWA C104. Cement mortar lining shall be twice the standard thickness.

- E. Mechanical joint retainer glands shall be installed on all mechanical joints. Retainer glands shall be specifically designed to fit standard mechanical joint bells with corrosion resistant, low-alloy T-head bolts conforming to ANSI/AWWA C 111/A21.11 and ANSI/AWWA C153 / A21.53 of latest revision. Retainer glands shall be manufactured of ductile iron conforming to ASTM A536-80 grade 60-42-10. Set screws shall be of hardened ductile iron and require the same torque in all sizes. Steel set-screws are not permitted. These devices shall have a minimum 250 psi pressure rating with a minimum safety factor of 2:1 and shall be EBAA IRON, Inc., series 1100 or approved equal. Glands shall be listed with Underwriters Laboratories and/or approved by Factory Mutual.

- F. Couplings and transitional couplings for pipe $\leq 12''$ in diameter shall consist of a long body cast iron sleeve and shall have gaskets suitable for the pipe being joined. The bolts and nuts shall be corrosion resistant alloy steel such as Cor-Ten steel or an approved equal. Couplings shall be Romac style 510, Dresser style 153, Rockwell type 441, or approved equal. Transition couplings for pipe $\leq 12''$ in diameter shall be Dresser Style 162, Rockwell Type 441 or approved equal.

- G. Steel couplings shall be provided with an epoxy coating.

- H. Solid sleeves shall have long body type (12" min.) and mechanical joints with retainer glands.

- I. Test connections, blow offs and air release valves shall be installed in the piping for pressure testing and disinfection at locations ordered by the Engineer (there shall be no separate payment for this work).
 - 1. Corporation cocks for air release and test connections shall be in accordance with ANSI/AWWA C800-84 and shall be $\frac{3}{4}$ diameter with CC thread on inlet by iron pipe thread flare on outlet as manufactured by Mueller, Ford, McDonald or approved equal.

 - 2. Copper tubing for the air release and test connections shall be annealed Type K soft tubing and shall conform to the requirements of ASTM Standard B88.

3. Upon completion of testing and disinfection, the corporation cock shall be removed and replaced with a brass plug and the copper tubing removed. The brass plug shall be field swabbed for disinfection in accordance with AWWA C651.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

A. Handling of Pipe and Fittings

1. Ductile iron pipe and fittings shall be unloaded and handled with a crane or backhoe of proper capacity outfitted with a steel cable sling, belt sling or other specially designed attachment to protect the pipe coating. Delivery of pipe and fittings shall be coordinated with installation or shall be unloaded with proper equipment along the line of work outside the trench near as practicable to the point of final placement, facing in the proper direction and properly wedged secure. A notice of at least 24 hours prior to pipe deliveries shall be given to the Engineer. Notice shall include the method of unloading.

B. Storage of Materials

1. Store pipe in a manner to keep pipe interior free from dirt and foreign matter. Pipe shall not be stored on stones or other hard materials and shall not be stored on top of each other.
2. Contractor may store pipe at his yard if approved by Engineer. The Engineer shall be permitted reasonable access for inspection.
3. Materials subject to corrosion shall be protected in accordance with manufacturer's recommendations.

C. Handling Materials

1. Pipe shall be handled in such a manner so as to prevent damage to the concrete or mortar coating or lining.
2. Pipe shall be handled using methods approved by the pipe manufacturer.
3. Pipe damaged during handling will be rejected and shall be replaced at the Contractor's expense.
4. Every precaution shall be taken to ensure that no foreign materials enter the pipe during handling.

3.02 COORDINATION

- A. Existing mains may have to be shutdown to complete the connections as shown on the Drawings and as specified herein.
 - 1. All valves will only be operated by the Owner or Owner's representative.
 - 2. The Contractor shall submit all requests for shutdown of existing piping to the Engineer at least 5 working days prior to the operations and shall reschedule his operations as necessary to prevent conflicts with the Engineer and Owner's operations.

3.03 DEFECTIVE PIPE

- A. The Engineer reserves the right to reject all defective pipe shipped to the job site or stored on the site. The Engineer will examine the pipe and determine if the pipe is damaged prior to installation of the pipe in the trench. All defective pipe or fittings shall be rejected for use on this project. Defective pipe may be classified as follows:
 - 1. Damage to interior cement-mortar lining
 - 2. Insufficient cement-mortar lining thickness
 - 3. Pipe out of round
 - 4. Damaged pipe barrel area
 - 5. Damaged pipe bells or spigots
 - 6. Missing, misplaced or illegible marking and identification

3.04 JOB CONDITIONS

- A. Environmental Requirements
 - 1. Do not lay pipe when weather conditions are unsuitable, as determined by the Engineer, for pipe laying work.
 - 2. Equipment for pipe laying shall be maintained in good operating order.
 - 3. Job site shall be kept clean of debris and organized to carry out all operations in a safe and satisfactory manner.
- B. Protection
 - 1. At all times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the

Engineer. This provision shall apply during the noon hour and overnight, as well as during delays in the pipe laying operations.

2. Temporary Bulkhead

- a. Install approved temporary bulkhead on end of pipe at end of the day's work and when pipe laying is not actively in progress.

C. Work Affecting Existing Pipelines

1. Location of Existing Pipelines:

- a. Location of existing pipeline shown on the Drawings shall be considered approximate.
- b. Contractor is responsible for determining the exact location of existing piping to which he shall make connections, or which he may disturb during earth moving operations, or which may be affected by his work in any way.

2. Work on Existing Pipelines:

- a. Cut pipes as shown or required with machines specifically designed for this work.
- b. Install temporary plugs to keep out all mud, dirt, water and debris.
- c. Provide all necessary adapters, fittings, pipe and appurtenances required.

3.05 CLEANING PIPE AND FITTINGS

- A. All foreign matter shall be cleaned and removed from each pipe and fitting before placing in the trench. Remove pipe and fittings whose interior has been contaminated with oil, gasoline or kerosene and replace at no cost to the Owner. Remove pipe and fittings whose interior has been contaminated with any or other material which is a regulated drinking water contaminate or which damages the cement and replace at no cost to the Owner. Should foreign material or contaminates be observed in previously installed pipe, the Contractor shall cease work until foreign material or contaminated pipe is decontaminated or removed.
- B. All lumps, blisters, and excess coal-tar coating shall be removed from the bell and spigot ends of each pipe or fitting, and the outside of the spigot and the inside of the bell shall be wire-brushed and wiped clean and dry and free from oil and grease before the pipe or fitting is laid.
- C. On all ductile iron pipe or fitting, the bell of the pipe and the spigot of the adjacent pipe or fitting are to be wire-brushed and cleaned of all rust and dirt. The bell of the pipe or fitting and the spigot of the adjacent pipe are then to be lubricated

with the joint lubricant furnished with the pipe, and used in accordance with the manufacturer's directions.

3.06 ALIGNMENT AND GRADE

- A. All pipe shall be laid and maintained at the required lines and grades as shown on the Drawings. Fittings shall be at the required locations with joints centered, and spigots properly fitted. No deviation shall be made from the required line and grade, except with the approval of the Engineer.
- B. Joint Openings and Deflection:
 - 1. The maximum allowable joint openings and deflection for push-on joint pipe and restrained joint pipe shall be one-half the manufacturer's maximum allowable opening and deflection.
- C. Line or Grade Conflicts with Other Structures
 - 1. Wherever obstructions not shown on the Drawings are encountered during the progress of the Work and interfere to such an extent that an alteration in the Drawing is required, the Engineer shall order a deviation from the line and grade at locations where obstructions such as culverts, ducts, wire and/or pipes are encountered, the water mains shall be laid over or under such obstacles with a clearance of 6". In general, the choice of "over" or "under" will be shown on the Drawings, but the Engineer reserves the right to make any alterations at the time of construction.
- D. Where underground conditions indicate a change of alignment or grade, such change shall be made only with the written consent of the Engineer.

3.07 PIPE INSTALLATION

- A. General Requirements
 - 1. Use proper and suitable tools and appliances for the proper and safe handling, lowering into trench and layout of pipes.
 - 2. Proper implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe and fittings shall be carefully lowered into the trench piece by piece by means of a derrick, ropes or other tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.
 - 3. All pipe and fittings shall be carefully inspected for cleanliness and defects prior to placing them in the trench.

B. Laying Pipe

1. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipelaying crew cannot put the pipe into the trench and in place without getting earth into it, the Engineer may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.
2. When laying pipe the spigot end shall be centered in the bell, the pipe forced home and the joint completely assembled. The pipe is then to be adjusted to correct line and grade and to be secured in place with approved backfill material, properly tamped under and around the pipeline.
3. When laying the pipeline, any fittings which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe or fittings of proper dimensions to ensure a uniform space and a satisfactory joint.

C. Cutting Pipe

1. All pipe furnished on the job will be furnished in full lengths. All cutting of ductile iron pipe required for inserting valves, fittings or closure pieces and all cutting of pipes required for nipple pieces shall be done by the Contractor in a neat and workmanlike manner without damage to the pipe or cement lining. The cutting is to be done so as to leave a smooth end at right angles to the axis of the pipe.
2. Cutting of ductile iron pipe shall be accomplished either by the use of compression-type chain cutters which exert an even continuous force on the wall of the pipe or by power driven abrasive wheels. The cutting is to be carried out so as to leave a relatively smooth end at right angles to the axis of the pipe.
3. On ductile iron pipe using rubber joints, the outside edge of the cut end must be tapered back approximately $\frac{1}{4}$ " at an angle of about 30° so as to provide for the proper assembly of this joint.
4. This beveling of the outside edge of the end of the pipe can be done with a coarse file or portable grinder.

D. Permissible Deflection at Joints

1. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or where long-radius

curves are permitted, the amount of deflection allowed shall not exceed that required for satisfactory making of the joint, and shall be approved by the Engineer.

2. Prior to deflecting the pipeline, the spigot of the pipeline should be marked flush with the bell end to assure that the spigot is not withdrawn as the result of the deflection. After the pipe is deflected, an adequate depth of jointing material must remain on the side where the spigot is away from home and an adequate width of caulking space must remain on the opposite side of the pipe at the face of the bell.
3. In general, all radius curves called for on the Drawings or permitted at the time of construction are to be made using full lengths of pipe. The use of short lengths of pipe and extra joint in order to make a smaller radius turn will not be allowed without the written approval of the Engineer.

3.08 PUSH-ON JOINTS

- A. Push-on joints shall be made in accordance with the manufacturer's instructions. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe to be laid shall then be aligned and inserted in the bell of the pipe to which it is to be joined, and pushed home with a jack or by other means. After joining the pipe, a metal feeler shall be used to make certain that the rubber gasket is correctly located.

3.09 MECHANICAL JOINTS

- A. Mechanical joints shall be made in accordance with Appendix A of ANSI/AWWA C111 and the manufacturer's instructions. Thoroughly clean and lubricate the joint surfaces and rubber gasket with soapy water before assembly. Bolts shall be tightened to the specified torques. Under no conditions shall extension wrenches or an extended handle ratchet wrench be used to secure greater leverage.

3.10 RESTRAINED JOINTS

- A. Restrained joints shall be installed where shown on the Drawings. The joint assemblies shall be made in accordance with the manufacturer's recommendations.

3.11 CONCRETE THRUST BLOCKS

- A. Poured-in-place concrete thrust blocks shall be placed at the locations shown on the Drawings, or as directed by the Engineer. All poured-in-place thrust blocks must be formed with wood forms, and the Contractor is advised that rough earth forms will not be acceptable. The pipeline materials and fittings shall be protected from direct adherence of the concrete thrust block by being wrapped in plastic, roofing felt, reinforced manila paper or similar material. The thrust block shall not bear directly on the joint and shall not interfere with future adjustments, tightening, or removal of the joint. All thrust blocks shall bear against undisturbed

soil at the side or end of the trench and this undisturbed surface shall be carefully cleaned off so as to be vertical. The thrust blocks shall have a minimum horizontal thickness of 2' and shall have the minimum bearing area listed on the Drawings, measured perpendicular to the direction of thrust.

3.12 DISINFECTION

- A. All pipe fittings and valves installed under this contract shall be disinfected in accordance with Aquarion requirements.

3.13 TESTING

- A. All pipe, fittings and valves installed under this contract shall be tested in accordance with Aquarion requirements.

3.14 DEACTIVATION OF WATER MAINS

- A. The Contractor shall excavate and remove sections of the existing water main as shown on the Drawings. Repairs and capping of the main shall be in accordance with the Drawings.
- B. After the pipe has been capped, the top sections of all gate boxes shall be removed, stacked and returned to the owner, the holes filled in with suitable backfill material and patched with bituminous concrete in the area of the gate box.
- C. The deactivation of the water mains shall be done upon completion of:
 - 1. Installation and successful testing of the new pipeline including all hydrants and appurtenances,
 - 2. Disinfection of the installed pipelines, and
 - 3. Removal and reconnection of all buildings from the existing pipelines to the new pipelines. Surface repair methods shall meet the requirements of the applicable surface repair item, and shall be in accordance with the treatments shown on the project plans.

****END OF SECTION 33 11 00****

SECTION 33 14 19

VALVES AND HYDRANTS

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section is for buried valves, including valves inside below-grade valve vaults.
- B. Section Includes
 - a. Gate Valves
 - b. Valve Boxes
 - c. Fire Hydrants
- C. Related Sections
 - 1. Section 31 00 00 - Excavation, Backfill, Compaction and Dewatering
 - 2. Section 31 23 22 – Trenching and Backfilling
 - 3. Section 33 11 00 – Water Utility Distribution Piping

1.02 REFERENCES

- A. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
- B. AWWA C111 - Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
- C. AWWA C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
- D. AWWA C207 – Steel Pipe Flanges for Waterworks Service – Sizes 4 Inch Through 144 Inch (100 mm Through 3,600 mm)
- E. AWWA C500 – Metal-Seated Gate Valves for Water Supply Service

1.03 SYSTEM DESCRIPTION

- A. Furnish all labor, materials, equipment, and incidentals required to install, complete and ready for operation, all valves, hydrant assemblies, and appurtenances as shown on the Contract Drawings and as specified herein.
- B. Valves for water distribution systems.

1.04 SUBMITTALS

- A. Submit complete Shop Drawings of all valves, valve boxes, hydrants and other material specified in this Section including but not limited to the following:
 - 1. Product data including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Ensure valves are dry and internally protected against rust and corrosion.
 - 2. Protect valve ends against damage to threads, flange faces, and weld-end preps.
 - 3. Set valves in best position for handling:
- B. Use the following precautions during storage:
 - 1. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.
- C. Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Valves, hydrants, and appurtenances shall conform to the standards of the Aquarion Water Company of Connecticut and the City of Stamford.
- B. Valve sizes shall be the same size as the upstream pipe, unless otherwise indicated.
- C. Provide accessories including bolts, nuts, glands, and gaskets.
- D. Valves shall have the same end connections as the pipeline in which it is installed.

- E. Buried valves shall have mechanical joint ends compatible with the piping systems in which they are installed in accordance with ANSI/AWWA C111/A21.11-85 and Mega-Lug type retainer glands. Provide mechanical joint accessories, including glands, SBR rubber gaskets, tee head bolts, and nuts with the valves. Provide stainless steel bolts and nuts.
- F. Mechanical joint ends shall be compatible with ductile iron O.D. pipe.
- G. Valves and appurtenances shall be of the size shown on the Contract Drawings.
- H. Equipment of the same type shall be from one manufacturer, unless otherwise approved.
- I. Valves, hydrants, and appurtenances shall have the name of the manufacturer, flow directional arrows, and the working pressure for which they are designed cast in raised letter upon some appropriate part of the body.
- J. Valves for water distribution systems shall be certified to NSF 61 and NSF 372.
- K. Bolts shall be 304 stainless steel with hex heads and hex nuts in accordance with ASTM A-307 and A-563, respectively.
- L. Provide buried valves with standard valve box with tee-handle operator.
- M. Valves installed inside buried structures shall be hand-wheel or lever operated.

2.02 GATE VALVES

- A. Gate valves shall be resilient seat type suitable for underground service complying with the requirements of AWWA C509 or C515. C509 gate valves shall be cast iron or ductile iron. C515 gate valves shall be ductile iron.
- B. Gate valves shall be designed to be bubble tight for 250 psig water working pressure with no leakage past the seat from either side of the disc, and shall be hydrostatically tested to 500 psig.
- C. Gate valves shall be of the non-rising stem (N.R.S.) design.
- D. Gate valves shall be set vertically (spur gearing).
- E. Gate valves shall be set horizontally (bevel gearing).
- F. Gate valves shall open left (counter-clockwise).
- G. Buried gate valves shall be furnished with 2 inch square operating nuts.
- H. Open-left gate valves shall have a black-painted operating nut, and open-right valves shall have a red-painted operating nut.
- I. Cast iron shall meet the specifications of ASTM A126, Class B. Castings shall be clean and sound without defects that will impair their service. No plugging or

welding of such defects will be allowed. Ductile iron shall meet the standards of ASTM A536.

- J. The resilient-seated disc wedge shall be of the resilient wedge fully supported type, either cast iron or ductile iron. Solid guide lugs shall travel within channels in the body of the valve. The disc and guide lugs shall be fully encapsulated in SBR (styrene butadiene rubber) or EPDM rubber. Disc wedges that are not 100% fully encapsulated shall not be acceptable. Provide guide caps of an acetal copolymer bearing material to protect the rubber-encapsulated solid guide lugs from abrasion for long life and ease of operation.
- K. The seat shall be SBR or EPDM rubber, matching the disc encasement. The seating surface (rubber) shall be specially designed so as to provide a smooth waterway, without depressions or cavities, which might trap debris and interfere with tight closures.
- L. The body, bonnet, and gate shall be cast/ductile iron, constructed in accordance with AWWA C509 or C515. The bonnet to body seal shall incorporate a flat neoprene gasket. Bonnet and body flanges shall be fully machined to assure proper sealing of the gasket.
- M. Gate valve stems shall be of bronze rolled bar stock in accordance with ASTM B584, and shall have a forged thrust collar. The thrust collar shall be factory lubricated, and the thrust collar and its lubrication shall be isolated by the O-Rings from the water way and from outside contamination, providing permanent lubrication for long term ease of operation. An anti-friction thrust washer shall be provided both above and below the thrust collar for ease of operation.
- N. Gate valves shall have O-Ring sealed stems with one O-Ring located below the thrust collar and two O-Rings located above the thrust collar. The two O-Rings located above the thrust collar shall be replaceable with the valve still in service in the fully open position.
- O. Coat internal and external exposed ferrous surfaces of the valve with a fusion-bonded, thermosetting powder epoxy coating suitable for potable water service conforming to AWWA C550. Coating shall be non-toxic and shall impart no taste to water. Coating thickness shall be nominal 10 mils. Gate valves for water distribution systems shall be certified to NSF 61.
- P. Seal internal and external exposed ferrous surfaces of the valve with two coats of asphaltic varnish (5 mils) suitable for potable water service conforming to AWWA C550. Coating shall be non-toxic and shall impart no taste to water. Coating thickness shall be nominal 10 mils. Gate valves for water distribution systems shall be certified to NSF 61.
- Q. Gate valves shall be as manufactured by U.S. Pipe Metroseal (Model 250), Mueller (Model 2360), American Flow Control (AFC-2500), Clow (2630 Series), equivalent by M&H Valve Company, or equal.

2.03 TAPPING SLEEVES/VALVES

- A. Ductile Iron Tapping Sleeves for Pipes 12-Inches and Smaller
1. Tapping sleeve shall be MJ, with recessed outlet flange for tapping valve.
 2. Tapping sleeve shall conform to AWWA C-207, Class D, with rated maximum working pressure of 200 psi.
 3. The side rubber gaskets shall be rectangular in cross-Section and fit into grooved channels in the casting. These gaskets shall extend the entire length of the sleeve and shall not require cutting or trimming to match MJ end gaskets.
 4. Tapping sleeve shall be AB-CD pattern to permit use of plain rubber and duck-tipped gaskets for various O.D. piping sizes.
 5. Mechanical joint with accessories furnished including glands, gaskets, and Cor-Ten T-bolts and nuts, or equal.
 6. Flange outlet bolts shall be 304 stainless steel.
 7. Interior and exterior to be bituminous coated with a minimum of 4 mils dry film thickness or fusion bonded epoxy coating.
 8. The sleeve shall be provided with a $\frac{3}{4}$ inch F.I.P.T. test port and brass plug.
 9. Approved manufacturers:
 - a. AFC
 - b. Mueller Co.
 - c. U.S. Pipe
 - d. Tyler/Union

2.04 VALVE BOXES

- A. Provide a valve box of the adjustable type of heavy pattern, constructed of cast iron and provided with a 6 inch cast iron cover for each buried valve.
- B. Valve boxes shall be manufactured in North America by Clow Corporation, Tyler/Union Corporation, United States Foundries, or equal.
- C. Valve boxes shall be round, 2-piece, sliding type, cast iron. The upper section of each box shall have a flange on top having sufficient bearing area to prevent settling. The bottom of the lower section shall be belled to enclose the operating nut of the valve. The barrel shall be 5-1/2 inch O.D. minimum.

- D. Boxes shall be of lengths consistent with pipe depths. Boxes shall be adjustable, with a lap of at least 6 inches when in the most extended position.
- E. Slot covers for easy removal.
- F. Covers for valve boxes on water mains shall have the word "WATER" cast in the top.
- G. Coat valve boxes with coal-tar pitch enamel or other approved coating.
- H. Valve boxes shall be suitable for the size valve on which they are used. The length of the lower section shall be adequate for trench adjustment, no top or mid-section adapters.
- I. Provide one tee-handled wrench for every four valves installed, unless additional wrenches are required due to variations in valve bury depth. Wrenches shall be field measured to accommodate the depth of bury and provide waist high operation.
- J. Provide lockable valve box covers where indicated on the Drawings. Lockable valve box covers shall be Quality Water Products Lok'n Rise Valve Box Cover, or equal.

2.05 FIRE HYDRANTS

- A. Fire Hydrants
 - 1. The hydrant shall meet the requirements of AWWA Standard C-502, latest edition, and may be salvaged hydrants from the site provided that they are in working order as determined by the City of Stamford, otherwise new hydrants shall be installed.
 - 2. The hydrant operating nut shall open in the direction as required by the City of Stamford, which shall confirm all material aspects identified below.
 - 3. Operating nut
 - a. Shall be D.I. or bronze.
 - b. Shall be 1-1/2 inch diameter, pentagon in shape.
 - 4. Nozzles
 - a. 2 each – 2-1/2 inch National Standard Thread
 - b. 1 each – 4-1/2 inch National Standard Thread
 - 5. Provide nozzle caps without chains and with the same size pentagon operator as specified above.
 - 6. Provide traffic model hydrant with breakaway feature.

7. Hydrant shoe or base features
 - a. Ductile iron with 6 inch MJ inlet
 - b. 5-1/4 inch valve opening with draining bronze seat and drain ports to allow water within the hydrant barrel to drain to the exterior.
 - c. Valve seat and sub-seat arrangement shall be bronze to bronze.
 8. Bolts and Nuts
 - a. Bolt and nuts shall be stainless steel.
 9. Protective coatings
 - a. Provide a minimum of 3 mils total dry film thickness for all paintings and coatings.
 - b. The internal components of the hydrant shall be fusion-epoxy coated.
 - c. Coat internal and external cast iron or ductile iron components with an approved bituminous sealer or a fusion bonded epoxy coating, 3 mils minimum.
 10. Approved hydrants
 - a. Per City of Stamford Fire Department.
- B. The hydrants shall comply with all requirements of AWWA Standard C502-80 and the following requirements:
1. The hydrant shall be a compression type shut-off with valve opening against the pressure. A negligible loss of water shall occur with breakage of the hydrant, whether breakage occurs in the open position or the closed position.
 2. The main valve seat shall be 5¼ inches in diameter.
 3. The inlet connection shall be 6-inch mechanical joint furnished with gasket, gland and bolts.
 4. The color of the hydrant above ground shall match the City of Stamford's standard color.
 5. Connecting pipe and pipe nipples between the main line tee and hydrant shall be 6 inch ductile iron, Class 52, conforming to the requirements of Section 02514.
 6. 6 inch hydrant valve and valve box shall conform to the requirements of this section.

7. Anchoring tees shall have main run ends as indicated on the Drawings or as required for the installation. The 6 inch branch shall have a plain end with an integral gland and rotating mechanical joint gland to provide a restrained connection for the valve.
8. Minimum working pressure shall be 250 psi.
9. The hydrant tee shall be designed so that the hydrant valve can be securely attached to the main line.

C. Hydrant Paint

1. Thoroughly clean hydrants and paint with two shop or field coats in accordance with AWWA C502 and the instructions of the paint manufacturer.
2. Provide a factory-applied fusion-bonded epoxy coating. Coating color shall be the Owner's standard.
3. Alkyd gloss enamel shall be 801 DTM by Sherwin-Williams, 2H-Tneme by Tnemec, or equal. Reflective paint shall be Scotchlite #7211 by 3M.
4. Hydrant color shall be City of Stamford's standard color.

D. Additional Hydrant Components

1. Supply a minimum of 2 operating wrenches compatible with hydrants.
2. Supply a minimum of 2 repair kits compatible with the hydrants being supplied that includes all special tools required to maintain the hydrants (e.g., hose nozzle insertion tool, pumper nozzle insertion tool, hydrant disassembly wrench, etc.).

E. Removing and Resetting Existing Hydrants

1. Existing hydrants designated to be reinstalled shall be removed from the existing water main and reinstalled on the new water main as shown on the Drawings. Provide a new main-line anchoring tee to connect to the new main, 6 inch gate valve and box, and 6 inch nipple as required to reconnect the existing hydrant.

F. Anchoring Tees

1. Hydrant tees shall be the "anchoring" type and shall have mechanical joint bells conforming to the requirements of the main pipe. The anchoring tee outlet shall be 6 inch mechanical joint, equipped to anchor the hydrant valve to the tee.
2. Anchoring tees shall have mechanical joint main run ends. The branch shall have a plain end with an integral gland and rotating mechanical joint gland to provide a restrained connection.

G. Tie Rods

1. Tie rods utilized for joint restraints shall be manufactured by Star national Products, Columbus, OH, and shall consist of Star Figure SST7 tie bolts with Figure SST8 nuts, Figure SST17 tie washers, and Figure SST12 all thread tie rods. Tie bolts, tie washers, tie rods, and nuts shall be COR-TEN type steel.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.
- B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.
- C. Examine threads on both the valve and the mating pipe for form (i.e., out-or-round or local identification) and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.
- F. Replace defective valves with new valves.

3.02 HYDRANT INSTALLATION

- A. Excavation, trenching and backfilling procedures shall be in accordance with Sections 31 00 00 and 31 23 33.
- B. Provide thrust blocks for all hydrants with bearing against the foot or bottom of the hydrant and against the vertical face of undisturbed soil behind the hydrant. The bearing areas of the thrust block on the soil shall be as shown on the Drawings.
- C. Provide one cubic yard of washed $\frac{3}{4}$ inch stone around hydrant drains.
- D. Hydrants shall be located 3 to 5 feet behind the existing edge of the curb from the face of the fogger nozzle nut, where space between curb and sidewalk permits. Where space does not permit, set hydrants with the back of the hydrant

at the edge of the sidewalk in the tree belt. Where the sidewalk abuts the back of the curb, set the hydrant face 12 inches from the face of the curb.

- E. Hydrant breakaway flanges shall be located no higher than 3 inches above-grade or lower than at-grade.
- F. Support buried valves 6 inches and larger with a concrete pad.
- G. Install gate valves in the vertical position.
- H. Air test tapping sleeves prior to beginning tapping operations.
- I. Existing valves and hydrants will be operated only by Aquarion Water Company or City of Stamford personnel.
- J. All newly installed hydrant and branch connections shall be subject to line pressure in an open trench to determine tightness of joints before backfilling, unless they are part of the overall pipeline pressure and leakage testing.
- K. Install fire hydrants in accordance with the Drawings and the manufacturer's recommendation.

3.03 VALVE INSTALLATION

- A. Refer to the Drawings and piping system specification sections for specific valve applications and arrangements.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.
- D. Install valves in horizontal piping with stem at or above the center of the pipe.
- E. Install valves in a position to allow full stem movement.
- F. Install valves and actuators to be plumb in the vertical direction.
- G. Threaded Connections
 - 1. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
 - 2. Align threads at point of assembly.
 - 3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).

4. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

H. Mechanical Joint Connections

1. Refer to Section 33 11 00 for requirements for installing mechanical joint connections.

I. Flanged Connections

1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.04 FIELD QUALITY CONTROL

- A. After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.05 CLEANING

- A. Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

3.06 FINAL ACCEPTANCE AND WARRANTY

- A. Final acceptance of all equipment furnished under these Specifications will be withheld until after the installation and field testing by the Engineer. The manufacturer and the Contractor shall guarantee the equipment against defects of any kind for a period of one year after final testing and acceptance.

****END OF SECTION 33 14 19****

SECTION 33 40 00

STORM DRAINAGE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide storm drainage systems, including all pipes, fittings, joints, wyes and adapters, in accordance with the Contract Documents.
- B. Related Work Specified Elsewhere:
 - 1. Section 02 32 19 – Subsurface Investigations
 - 2. Section 31 23 33 – Trenching and Backfilling
 - 3. Section 31 25 00 – Erosion and Sediment Controls
 - 4. Section 33 11 00 - Water Utility Distribution Piping

1.02 COORDINATION

- A. Coordinate and schedule the work of this Section with all trades involved to prevent interference, and in order to allow adequate time at the proper stage of construction to properly perform all work of this Section.

1.03 REQUIREMENTS AND RESTRICTIONS

- A. Requirements given herein may be affected by other related requirements of the project specifications. Correlation of all contract requirements is the responsibility of the Contractor.
- B. Connect to storm drain lines at a point five (5) feet outside the building lines. All drain lines within a point five (5) feet outside the building lines are specified in the Plumbing Division.
- C. Work to comply with all applicable codes and regulations. Furnish all bonds necessary to get a permit for cuts and connections to sewer.
- D. The term "Local Standards" as used herein, means the standards of design and construction of the City of Stamford, or State of Connecticut, whichever is applicable.
- E. Maintain in operating condition all active utilities, sewers, gutters and other drains encountered in the utility installation. Repair to the satisfaction of the Owner any surface or subsurface improvements damaged during the course of the Work

(unless such improvement is shown to be abandoned or removed), whether or not such improvement is shown on the Drawings.

1.04 APPLICABLE STANDARDS

- A. City of Stamford applicable standards for roads, sewers and utilities.
- B. Standard Specifications for Roads, Bridges and Incidental Construction Form 817 as issued by the State of Connecticut Department of Transportation, 2016 edition with all latest amendments thereto.

1.05 SUBMITTALS

- A. Structure details for manholes, catch basins, trench drains, rims, frames, grates, etc.
- B. Certification of Specification Compliance.
- C. All piping certifications, casting data and the like as may be required by the Owner.
- D. Permanently mark all catch basins, yard drains, trench drains with an approved label stating "Don't Dump, Drains to Long Island Sound". Submit labeling plan to Engineer and Owner for approval.
- E. As-built drawings as specified within this Section.
- F. Certification of conformance with Construction Documents.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Pipe:
 - 1. Polyvinyl Chloride (PVC) Pipe: Pipe and fittings shall to conform to ASTM D 3034 "Type PSM Polyvinyl Chloride (PVC) Sewer pipe and fittings, Class SDR-35." The minimum modulus of elasticity shall be 400,000 psi.
 - 2. Reinforced concrete pipe (RCP): Pipe shall to conform to AASHTO M170 Class IV or Class V, as noted on plans. Where no class is identified, pipe shall be Class IV.
 - 3. Corrugated High Density Polyethylene pipe and pipe fittings to conform to AASHTO M294Types. Joints to be watertight and conform to ASTM D3212 and gaskets to conform to ASTM F477.
- B. Manholes and Catch Basins:
 - 1. Concrete - 4,000 p.s.i. to comply with requirements and workmanship set forth in the referenced standards.

2. Ensure precast structures are yard manufactured of 4,500 p.s.i. material and are in accordance with standard details as shown on the drawings - ASTM C-478 and in compliance with Section M.08.02.4 of the reference standard.
3. Concrete block for drainage structures to be precast solid segmental blocks at least 5" x 8" by thickness shown and/or required, ASTM C-443 and in compliance with Section M.08.02.3 of the reference standard.
4. Brick for adjustment - ASTM C-32, MS, solids.
5. Ensure frames and covers or gratings are provided where indicated on the drawings of cast iron conforming to ASTM A-48, Class 30 and are similar and equal to Neenah Products as required by drawing details. Machine casting frame and grating seats to prevent rocking. Unit assemblies to comply with Section M.08.02.5 of the reference standard.

C. Junction Chambers

1. Layout plan of junction structure including openings for existing and proposed pipes (inverts and diameter information).
2. Type, size, location and spacing of steel reinforcing and inserts for anchoring threaded deformed steel bars. Bending diagrams, material lists and catalog cuts for inserts shall be provided.
3. Material designations.
4. Working drawings shall be stamped by a Professional Engineer licensed in the State of Connecticut. Each sheet of the working drawings shall be stamped.
5. Design computations for static, active (HS-20) and combined loads, as well as buoyancy calculations. These computations shall be stamped by a Professional Engineer licensed in the State of Connecticut.

D. Backfill:

1. The backfill envelope of select material, consisting of crushed stone and sand, for storm drain piping shall meet the following gradation:
 - a. 100% passing 1/4-inch sieve; not more than 35% passing the No. 50 sieve; not more than 10% passing the No. 100 sieve.
 - b. All percentages are by weight and shall be determined in accordance with ASTM D422.

E. Roof Leader Adapters shall have integrated cleanout.

- F. Balance of materials shall be as indicated on the Drawings and/or specified elsewhere in this Section.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Provide adequate survey controls to construct the utility lines and structures as shown on the Drawings. Deviations from the plans will be permitted only with the approval of the Owner. Provide an "as-built" record made by a licensed surveyor registered in the State of Connecticut, and paid for by the Contractor, showing all actual locations, inverts, grades, etc. Furnish one set to the Owner and one set to the Site Engineer.
- B. Examine the areas and conditions under which the site storm drainage system is to be installed. Notify the Owner in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.
- C. Dig test pits at the locations shown on the Drawings or ordered by the Owner before installation of storm drainage systems in accordance with Section 02 32 19. Notify Engineer 48 hours before start of test pits. Test pit excavations shall have neat, clean cut and vertical sides. Provide Engineer with survey of utilities within the hole showing horizontal and vertical location of top and bottom of all pipes, ducts and structures and a description of size and type of material.

3.02 TRAFFIC CONTROL

- A. Maintain access for vehicular and pedestrian traffic as required for other construction activities concurrent with storm drainage installation.

3.03 INSTALLATION, RCP

- A. Lay out all drainage systems, starting from the downstream end, true to line and grade to provide positive pitch, and place "in-the-dry", using laser or equivalent means to assure positive pitch and consistent grade,
- B. Length of piping shown is approximate. Provide all piping required to complete system.
- C. Excavate trench in accordance with Section 31 23 33, Trenching and Backfilling.
- D. Lay pipe true to the lines and grades shown on the Drawings or ordered by the Engineer.
- E. Before laying pipe, wipe the insides of sockets and outside of spigots clean of all dirt, grease, sand or water. Lay the pipe on a thoroughly tamped and compacted six (6) inch bed formed by building up a trough in accordance with ASTM D1557 one half of the height of the pipe barrel. Where pipe is placed in rock, excavate rock to a depth of six (6) inches below the bottom of the pipe, and the bottom of

trench shall be bedded with ASTM D1557 or similar material acceptable to the Engineer. Thoroughly tamp the bedding and consolidate as a bed for the sewer pipe. Do not rest the pipe on slabs, piers, bricks, planks, etc. under any circumstance.

- F. Where soft foundation is encountered in the progress of the Work, Contractor to remove such soft foundations as unsuitable material and material as described in the excavation of unsuitable material or as ordered by the Owner's Geotechnical Consultant. Place crushed stone not less than six inches in depth in wet trenches as bedding to support pipe and structures, on the order of the Owner's Geotechnical Consultant. Ensure stone is of a quality acceptable to the Owner's Geotechnical Consultant and not larger than will pass through a one (1) inch ring.
- G. Conduct backfilling so that no stone having a dimension larger than five (5) inches shall be placed within six (6) inches of completed sewer line and none larger than nine (9) inches in diameter shall be placed less than fifteen (15) inches above the pipe.
- H. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.
- I. At the point where the proposed sewer construction meets a live or exiting sewer, the new sewer shall be securely plugged with brick and mortar until the entire new sewer construction is completed and ready for final inspection. No deviations from this provision will be allowed.

3.04 INSTALLATION, PVC

- A. Store and handle PVC piping in accordance with manufacturer direction.
- B. Lay out all drainage systems, starting from the downstream end, true to line and grade to provide positive pitch, and place "in-the-dry", using laser or equivalent means to assure positive pitch and consistent grade,
- C. Trenching and backfilling shall be in accordance with Section 31 23 33, unless modified by manufacturer direction, in which case the more stringent standard shall apply.
- D. Install PVC piping in accordance with pipe manufacturer's instructions. Use joint adhesives as recommended by manufacturer to suit basic pipe materials.

3.05 INSTALLATION, HDPE

- A. Store and handle HDPE piping in accordance with manufacturer direction.
- B. Lay out all drainage systems, starting from the downstream end, true to line and grade to provide positive pitch, and place "in-the-dry", using laser or equivalent means to assure positive pitch and consistent grade,

- C. Trenching and backfilling shall be in accordance with Section 31 23 33, unless modified by manufacturer direction, in which case the more stringent standard shall apply.
- D. Install HDPE piping in accordance with pipe manufacturer's instructions. Use joint adhesives as recommended by manufacturer to suit basic pipe materials.

3.06 CLEANING DURING INSTALLATION

- A. Clean interior of new pipes of dirt and other superfluous material as Work progresses. Maintain swab or drag in line and pull past each joint as it is completed.
- B. Place plugs in ends of uncompleted pipe at end of day or whenever Work stops.
- C. Flush lines between manholes if required to remove collected debris.

3.07 JOINT ADAPTERS

- A. Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fitting.

3.08 ROOF DRAIN CONNECTIONS

- A. Connect roof drains to storm drainage system with standard adapter. Grout joints between PVC pipe, cast iron pipe and concrete pipes thoroughly with cement mortar to make watertight joints.

3.09 CLOSING ABANDONED UTILITIES

- A. Close open ends of abandoned underground utilities. Provide sufficiently strong closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.

3.10 INTERIOR INSPECTION

- A. Inspect conduit to determine whether line displacement or other damage has occurred.
- B. Perform inspections after lines between manholes or catch basin locations have been installed and approximately two feet of backfill is in place and at completion of Project.
- C. If inspection indicates poor alignment, debris displaced pipe, infiltration or other defects, correct such defects to the satisfaction of the Engineer. Debris to be disposed off-site at Contractor's expense.

3.11 PRECAST DRAINAGE STRUCTURES (REFER TO DETAILS)

- A. Inspect conduit to determine whether line displacement or other damage has occurred.

- B. Set brick and/or block in mortar with joints full and fill all joints.
- C. In manholes form invert channel of concrete, fill, smooth and accurately shape to conform to outside of adjoining pipe. Change direction of channel with true curve of as large as radius as possible.
- D. Where structures are constructed of solid concrete catch basin block, set block in cement mortar and fill all cross joints.
- E. Set frames and grates to proper elevations and in bed of mortar.
- F. Permanently mark all catch basins, yard drains, trench drains and deck drains with an approved label stating "Don't Dump, Drains to Long Island Sound". Submit label to Engineer and Owner for approval. Mark all inlets according to approved plan.
- G. All castings to be set on minimum of two courses of bricks or block to allow downward adjustment of grades in the future.
- H. Construct proprietary systems, such as the specified trench drain, in accordance with manufacturer requirements.

3.12 INSTALLATION – JUNCTION CHAMBERS

A. Installation

- 1. Construct junction chambers to the dimensions shown on the approved shop drawings and as specified. Protect all work against flooding and flotation.
- 2. Set wall sections so as to be vertical and with sections in true alignment with a ¼ inch maximum tolerance to be allowed. Seal the joints with the preformed flexible joint sealant used in sufficient quantity to fill 75% of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finish flush with the adjoining surfaces. Backfilling shall be done in a careful manner, bringing the fill up evenly on all sides. Construct sections in a manner that will result in a watertight joint.
- 3. Plug holes in the concrete walls required for handling or other purposes with a non-shrink grout or non-shrink grout in combination with concrete or rubber plugs, and finish flush on the inside.
- 4. Where a structure replaces an existing structure, removal of the existing structure shall be part of this item.

3.13 EXISTING UTILITIES

- A. Utility locations shown are approximate. Contractor shall determine exact locations before submitting bid.

- B. When encountered in Work or as indicated, protect existing active sewer, water, gas, electric, other utility services, structures; where required for proper execution of Work, relocate them as directed by the Utility Company responsible for the service. If existing active services are not indicated but are encountered, requiring protection or relocation, determine with utility company providing said service the appropriate action required to provide protection or method of relocation; advise Owner of all changes and manner of same.

3.14 CLEANING OF STORM DRAINS AND DRAINAGE APPURTENANCES

- A. At the conclusion of the work, all new and existing storm drains and drainage appurtenances on site, shall be given a final cleaning.
- B. Cleaning equipment may consist of hydraulic high pressure jet machines, heavy duty power rodding machines capable of cleaning distances covered under the Contract in one step and heavy duty bucket machines that can be used to drag line work with buckets, brushes, scrapers, swabs or other similar devices.
- C. Power rodding equipment shall have the capability of spinning the rod either clockwise or counter-clockwise. The equipment shall also be capable of pushing or pulling the rod without rotating the machine.
- D. The equipment utilized shall be capable of removing all sand, dirt, rocks and other debris, including roots (where ordered by the Engineer), from the drain line.
- E. The equipment used shall suit the conditions and size of the storm drain to be cleaned.
- F. Any drains damaged during the cleaning operations as a result of the Contractor's operations shall be promptly repaired to an acceptable condition (as determined by the Engineer) by and at the expense of the Contractor.
- G. If the Contractor's cleaning equipment becomes immobilized within a storm drain, exits the line through broken pipe or portions break off within a storm drain, said equipment shall be retrieved at the Contractor's expense. The Contractor shall act immediately to remedy problems created by the cleaning procedure, which represent a hazard to the general public, such as the collapse of the ground surface above a storm drain. If equipment retrieval necessitates excavation, the Contractor shall be responsible for accomplishing the work at his own expense. Following removal of the equipment, the Contractor shall restore the line and the site in accordance with the construction specifications.
- H. The Contractor shall dispose of the debris in a legal manner off site.
- I. The existing oil/water separators on the site shall be cleaned, the oil shall be removed and disposed of offsite in a legal manner. The remaining contents shall be evacuated and disposed of in a legal manner offsite. The depth of sediment removed and the volume of oil removed shall be recorded, Contractor shall provide written certification of cleaning and legal material disposal, and documenting the sediment depth and oil volume.

- J. Within 72 hours of cleaning all of the on-site pipe, the Contractor shall provide closed circuit television inspections of all the on-site storm drains, and produce a copy of the recording for the use of the City.
1. Television equipment used for the inspection shall be specifically designed and constructed for storm drain inspection.
 2. Lighting for the camera shall be suitable to allow a clear picture for the entire periphery of the pipe.
 3. The camera shall be operative in 100 percent humidity conditions and shall be capable of showing the entire inside periphery of the pipe.
 4. The camera shall develop and transmit a sharp picture on video bandwidths only.
 5. Picture transmission systems that require the use of R.F. suppressors and are subject to local transmitters' interference shall not be used.
 6. The camera shall be equipped with an automatic light compensating iris, adjustable optical focus and automatic white balancing circuitry.
 7. The camera adjustments shall be set to produce a clear, sharp picture of the internal conditions within the storm drain.
 8. The camera lens shall be cleaned prior to each deployment in the storm drain.
 9. A television picture with interferences, lines, blurry vision or distortions will not be acceptable.
 10. The camera shall be moved through the storm drain in either direction (dependent upon the site's condition) at a uniform, slow rate (no greater than thirty [30] feet per minute) that will allow a clear visual picture to be obtained.
 11. The camera shall pause for a minimum of three (3) seconds at every joint or defect observed with the storm drain to allow proper observation.
 12. Camera movement through the storm drain shall be accomplished by means of a winch and cables or by a motorized transporter (self propelled camera).
 13. The movement of the camera shall be remotely controlled by the television inspection operator from the inspection vehicle.

3.15 AS-BUILT SURVEY

- A. Provide adequate survey controls to construct the utility lines and structures as shown on the Drawings. Deviations from the plans will be permitted only with the

approval of the Owner. At the completion of construction, the Contractor shall retain the services of a Connecticut licensed land surveyor to prepare an "as-built" survey depicting all complete improvements. The survey map, as a minimum, shall be an "Improvement Location Survey" conforming to Class A-2 and T-2 accuracy as set forth in the Regulations of Connecticut State Agencies, Section 20-300b-1 through Section 20-300b-20. The survey map shall provide all rim, frame, and pipe invert elevations, and pipe sized. Furnish one set to the Owner and one set to the Site Engineer.

- B. Provide certification that the storm drainage system was installed in accordance with the approved plans.

****END OF SECTION 33 40 00****

SECTION 33 41 14

UNDERGROUND WARNING TAPE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Project Manual, apply to the Work of this Section.

1.02 SUMMARY

- A. Section Includes
 - 1. Underground Warning Tape

1.03 SUBMITTALS

- A. Shop Drawing Submittals
 - 1. Product Data

PART 2 - PRODUCTS

2.01 METALLIC WARNING TAPE

- A. Metallic warning tape for underground piping shall be polyethylene tape with metallic core for easy detection and location of piping with a metal detector.
- B. Tape shall be 6 inches wide.
- C. Tape shall be as manufactured by Seton Name Plate Corp., New Haven, Connecticut; Presco Detectable Underground Warning tape, Sherman, Texas; Blackburn Manufacturing, Neligh, Nebraska; Mercotape, Hackensack, New Jersey; or approved equivalent.
- D. The tape shall be of the type specifically manufactured for marking and locating utilities.
- E. The warning tape shall be heavy gauge 0.004 inch polyethylene and shall be resistant to acids, alkalis and other soil components. It shall be highly visible in the following colors with the associated phrases stamped in black letters and repeated at a maximum interval of 40 inches.

Type of Utility	Color	Warning Message
Sanitary Sewer	Green	CAUTION - SANITARY SEWER BURIED BELOW
Storm Drain	Green	CAUTION - STORM DRAIN BURIED BELOW
Water	Blue	CAUTION – WATER LINE BURIED BELOW
Electric	Red	CAUTION – ELECTRIC LINE BURIED BELOW
Telephone / Communications	Orange	CAUTION – TELEPHONE LINE BURIED BELOW
Gas	Yellow	CAUTION – GAS LINE BURIED BELOW

- F. The tape shall be of the type specifically manufactured for marking and locating utilities.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. All buried pipe and fittings shall be installed with metallic-lined underground warning tape located no more than 24 inches below final grade to allow detection by a metal detector.

****END OF SECTION 33 41 14****

SECTION 33 44 19

STORMWATER TREATMENT SYSTEM

PART 1 - GENERAL

1.01 Description

- A. Furnish and install stormwater treatment systems in accordance with the Contract Documents.
- B. Related Work Specified Elsewhere:
 - 1. Section 31 25 00 – Erosion and Sediment Controls
 - 2. Section 33 40 00 – Storm Drainage

1.02 COORDINATION

- A. Coordinate and schedule the work of this Section with all trades involved to prevent interference, and in order to allow adequate time at the proper stage of construction to properly perform all work of this Section.

1.03 REQUIREMENTS AND RESTRICTIONS

- A. Requirements given herein may be affected by other related requirements of the project specifications. Correlation of all contract requirements is the responsibility of the Contractor.
- B. Connect to storm drain lines at a point five (5) feet outside the building lines. All drain lines within a point five (5) feet outside the building lines are specified in the Plumbing Division.
- C. Work to comply with all applicable codes and regulations. Furnish all bonds necessary to get a permit for cuts and connections to sewer.
- D. The term "Local Standards" as used herein, means the standards of design and construction of the City of Stamford, or State of Connecticut, whichever is applicable.
- E. Maintain in operating condition all active utilities, sewers, gutters and other drains encountered in the utility installation. Repair to the satisfaction of the Owner any surface or subsurface improvements damaged during the course of the Work (unless such improvement is shown to be abandoned or removed), whether or not such improvement is shown on the Drawings.

1.04 APPLICABLE STANDARDS

- A. City of Stamford applicable standards for roads, sewers and utilities.

- B. Standard Specifications for Roads, Bridges and Incidental Construction Form 817 as issued by the State of Connecticut Department of Transportation, 2016 edition with all latest amendments thereto.

1.05 SUBMITTALS

- A. Structure details for each Stormwater Treatment System.
- B. Manufacturer guarantee of the Stormwater Treatment System against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the system is delivered to the Owner for installation.
- C. Manufacturer shall submit to the Engineer of Record a "Manufacturer's Performance Certification" certifying that each STORMWATER TREATMENT SYSTEM is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Stormwater treatment system shall be CDS by Contech Engineered Solutions, LLC, or approved equal.
- B. Housing unit of stormwater treatment device shall be constructed of pre-cast or cast-in-place concrete, no exceptions. Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:
 - 1. Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
 - 2. Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
 - 3. Cement shall be Type III Portland Cement conforming to ASTM C 150;
 - 4. Aggregates shall conform to ASTM C 33;
 - 5. Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185, or A 497.
 - 6. Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
 - 7. Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.

- C. Internal Components and appurtenances shall conform to the following:
1. Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
 2. Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
 3. Fiberglass components shall conform to the ASTM D-4097
 4. Access system(s) conform to the following:
 5. Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

2.02 PERFORMANCE

- A. The Stormwater Treatment System shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load or treat a flow rate designated by the jurisdiction in which the project is located. Both methods should be sized using a particle size distribution having a mean particle size (d_{50}) of 125 microns unless otherwise stated.
- B. The Stormwater Treatment System shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the Stormwater Treatment System's treatment efficiency as captured pollutants accumulate. The sump chamber shall be separate from the treatment processing portion(s) of the Stormwater Treatment System to minimize the probability of fine particle re-suspension. In order to not restrict the Owner's ability to maintain the Stormwater Treatment System, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.
- C. The Stormwater treatment System shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.
- D. The Stormwater Treatment System shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute Stormwater treatment System is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

- E. The Stormwater Treatment System shall have completed field tested following TARP Tier II protocol requirements

PART 3 - EXECUTION

3.01 PREPARATION

- A. Provide adequate survey controls to construct the utility lines and structures as shown on the Drawings. Deviations from the plans will be permitted only with the approval of the Owner. Provide an "as-built" record made by a licensed surveyor registered in the State of Connecticut, and paid for by the Construction Manager, showing all actual locations, inverts, grades, etc. Furnish one set furnished to the Owner and one set to the Site Engineer.
- B. Examine the areas and conditions under which the stormwater treatment system system is to be installed. Notify the Owner in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.

3.02 TRAFFIC CONTROL

- A. Maintain access for vehicular and pedestrian traffic as required for other construction activities

3.03 INSTALLATION

- A. The contractor shall exercise care in the storage and handling of the Stormwater Treatment System components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be borne by the contractor.
- B. The Stormwater Treatment System shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.
- C. The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.

- D. The contractor shall removal all loose material and pooling water from the Stormwater Treatment System prior to the transfer of operational responsibility to the Owner.

TABLE 1
Storm Water Treatment System
Storage Capacities

CDS Model	Minimum Sump Storage Capacity (yd ³)/(m ³)	Minimum Oil Storage Capacity (gal)/(L)
CDS2015-4	0.9(0.7)	61(232)
CDS2015-5	1.5(1.1)	83(313)
CDS2020-5	1.5(1.1)	99(376)
CDS2025-5	1.5(1.1)	116(439)
CDS3020-6	2.1 (1.6)	184(696)
CDS3025-6	2.1(1.6)	210(795)
CDS3030-6	2.1 (1.6)	236(895)
CDS3035-6	2.1 (1.6)	263(994)
CDS3535-7	2.9(2.2)	377(1426)
CDS4030-8	5.6(4.3)	426(1612)
CDS4040-8	5.6 (4.3)	520(1970)
CDS4045-8	5.6 (4.3)	568(2149)
CDS5640-10	8.7(6.7)	758(2869)
CDS5653-10	8.7(6.7)	965(3652)
CDS5668-10	8.7(6.7)	1172(4435)
CDS5678-10	8.7(6.7)	1309(4956)
CDS7070-DV	3.6(2.8)	914 (3459)
CDS10060-DV	5.0 (3.8)	792 (2997)
CDS10080-DV	5.0 (3.8)	1057 (4000)
CDS100100-DV	5.0 (3.8)	1320(4996)

3.04 EXISTING UTILITIES

- A. Utility locations shown are approximate. Contractor shall determine exact locations before submitting bid.
- B. When encountered in Work or as indicated, protect existing active sewer, water, gas, electric, other utility services, structures; where required for proper execution of Work, relocate them as directed by the Utility Company responsible for the service. If existing active services are not indicated but are encountered, requiring protection or relocation, determine with utility company providing said service the appropriate action required to provide protection or method of relocation; advise Owner of all changes and manner of same.

3.04 AS-BUILT SURVEY

- A. Provide adequate survey controls to construct the utility lines and structures as shown on the Drawings. Deviations from the plans will be permitted only with the approval of the Owner. At the completion of construction, the Contractor shall retain the services of a Connecticut licensed land surveyor to prepare an "as-built" survey depicting all complete improvements. The survey map, as a minimum, shall be an "Improvement Location Survey" conforming to Class A-2 and T-2 accuracy as set forth in the Regulations of Connecticut State Agencies, Section 20-300b-1 through Section 20-300b-20. The survey map shall provide all rim, frame, and pipe invert elevations, and pipe sized. Furnish one set furnished to the Owner and one set to the Site Engineer.

****END OF SECTION 33 44 19****

SECTION 33 71 19

ELECTRICAL UNDERGROUND DUCTS AND MANHOLES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 01 of the Project Manual, apply to the Work of this Section.

1.02 SUMMARY

- A. Provide utility services in accordance with Contract Documents. The Work includes but is not limited to the following:
 - 1. Install precast transformer pads and other required structures to complete the utility services as shown on the plans.
 - 2. Install underground electric services from existing or proposed manholes or poles to a point 5'- 0" outside building wall.

- B. Related Sections include the following:

- 1. Section 31 23 33 – Trenching and Backfilling
- 2. Section 31 25 00 – Erosion and Sediment Controls
- 3. Section 33 41 14 – Underground Utility Warning Tape

1.03 COORDINATION

- A. Coordinate and schedule the work of this Section with all trades involved to prevent interference, and in order to allow adequate time at the proper stage of construction to properly perform all work of this Section.

1.04 REQUIREMENTS AND RESTRICTIONS

- A. Requirements given herein may be affected by other related requirements of the project specifications.
- B. Correlation of contract requirements is the responsibility of the Construction Manager.
- C. Connect to utility services at a point five (5) feet outside the building lines.
- D. All utility services within a point five (5) feet outside the building lines are specified in Mechanical, Plumbing and Electrical Divisions.

- E. The Work shall comply with all applicable codes and regulations.
- F. The General Contractor shall furnish all bonds necessary to secure permits for cuts and connections to utilities and water.
- G. The term "Local Standards" as used herein, means the standards of design and construction of the respective municipal department and local Utility Companies.
- H. Said standards apply except where exceeded by this specification.
- I. Maintain in operating condition all active utilities, sewers, gutters and other drains encountered in the utility installation.
- J. Repair to the satisfaction of the Engineer any surface or subsurface improvement damaged during the course of the Work (unless such improvement is shown to be abandoned or removed), whether or not such improvement is shown on the Drawings.

1.05 STANDARDS

- A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of Eversource for electrical service and distribution.

1.06 SUBMITTALS

- A. Structure details.
- B. Certification of specification compliance.
- C. All piping, structures, conduit, etc., as may be required.

PART 2 - PRODUCTS

2.01 CONDUIT FOR UNDERGROUND DUCT BANK RUNS

- A. Trade diameter size as indicated on the Drawings but in no case less than 4".
- B. Polyvinyl chloride Schedule 40 duct, except extra heavy wall polyvinyl chloride Schedule 80 for vertical elbows and straight sections used to turn up through or penetrate building slabs or building foundation wall.
- C. Provide all materials for electric services in strict conformance to the requirements of the respective Utility Companies except as otherwise defined herein.
- D. Concrete for utility conduit encasement shall be 2,500 psi concrete.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine all Work prepared by others to receive Work of this Section and report any defects affecting installation to the Engineer for correction.
- B. Commencement of Work will be construed as complete acceptance of preparatory Work by others.

3.02 ELECTRIC SERVICE

- A. The following Work shall be performed by the Utility Company:
 - 1. Primary service.
 - 2. Transformers.
 - 3. Supply metering transformers.
 - 4. Final connections to metering equipment.
- B. The following Work shall be performed by the Contractor:
 - 1. Arrange with Utility Company for service facilities and pay all charges.
 - 2. Provide service from Utility Company source.
 - 3. Obtain Utility Company approval for all electric service Work and service equipment shop drawings.
 - 4. Install equipment and components where shown or as directed, in accordance with manufacturer's written instructions, Utility Company's instructions (where applicable), and with recognized industry practices, to ensure that installation complies with requirements and serves intended purposes.
- C. Coordinate with other Work as necessary to coordinate installation of equipment with other components of systems.
- D. Encase all conduits indicated as being incorporated into conduit banks in a concrete envelope as detailed on the Contract Drawings.
- E. Install conduit in such a manner as to provide a minimum cover as shown on the Drawings, after final grading.
- F. Increase the minimum cover as indicated or where required by field conditions.

- G. Lay conduit to avoid low points between structures by pitching from a high point between them, or from one to the next. The minimum pitch to be 3 inches per 100 feet.
- H. Exclude cold bending of plastic conduits to radii less than minimum recommended by conduit manufacturer. Use factory manufactured bends or field bend forming hot box as recommended by conduit manufacturer for radii less than the cold bending minimum.
 - 1. Bends in conduit shall have minimum radii as follows:
 - a. For primary feeder 15'-0", except where specifically indicated otherwise .
 - b. For primary feeder 4'-0" at termination point.
- I. Depress conduit banks below their basic depths as necessary to accommodate the structure entry dimensions and requirements set forth on manhole details. Change in depth shall be accomplished over a distance no less than 10'-0".
- J. Vary conduit spacing in duct banks as necessary to accommodate the structure entry dimensions and requirements set forth on manhole details. Change in spacing to be accomplished over a distance of no less than 10'-0".
- K. Install conduit so that adjacent joints are staggered at least 6 inches from one another.
- L. Join conduits utilizing the solvent cement supplied for the purpose by the manufacturer of the conduit.
- M. Terminate each plastic conduit at each structure in an end bell.
- N. Changes in elevation or depth below grade to be accomplished with two bends of not more than 45 degrees each.
- O. Accomplish offsets required by field conditions with two bends of not more than 10 degrees each.
- P. Plug both ends of all conduit stubs.
- Q. Identify all plugged conduit openings into structures. Identification to differentiate between openings for future conduits and openings into conduit stubs.
- R. Seal the end of each conduit run terminating inside a building utilizing a water and gas-tight sealant manufactured specifically for the purpose. Provide a similar seal at the other end of each such run where it enters the manhole nearest to the building.
- S. After conduit has been installed with concrete encasement, as required on the plans, clear each conduit of all obstructions and foreign matter by pulling a

flexible mandrel (12" minimum length and a diameter 1/4" less than that of the conduit) and brush through it.

1. In the event that obstructions are encountered in any conduit that will not permit the mandrel to pass, remove and replace the blocked section.
 2. Include in the Work all excavation, backfilling, repair of concrete encasement and restoration of surface at grade involved in the conduit replacement. Submit certification that all mandrelling has been satisfactorily completed.
- T. Provide a nylon cord for the pulling of cable in each conduit in which no cable is to be installed as part of the electric work.

****END OF SECTION 33 71 19****